Place a one cent stamp on this notice, mail the magazine, and it will be placed in the hands of our soldiers or sailors destined to proceed overseas. NO WRAPPER. NO ADDRESS.
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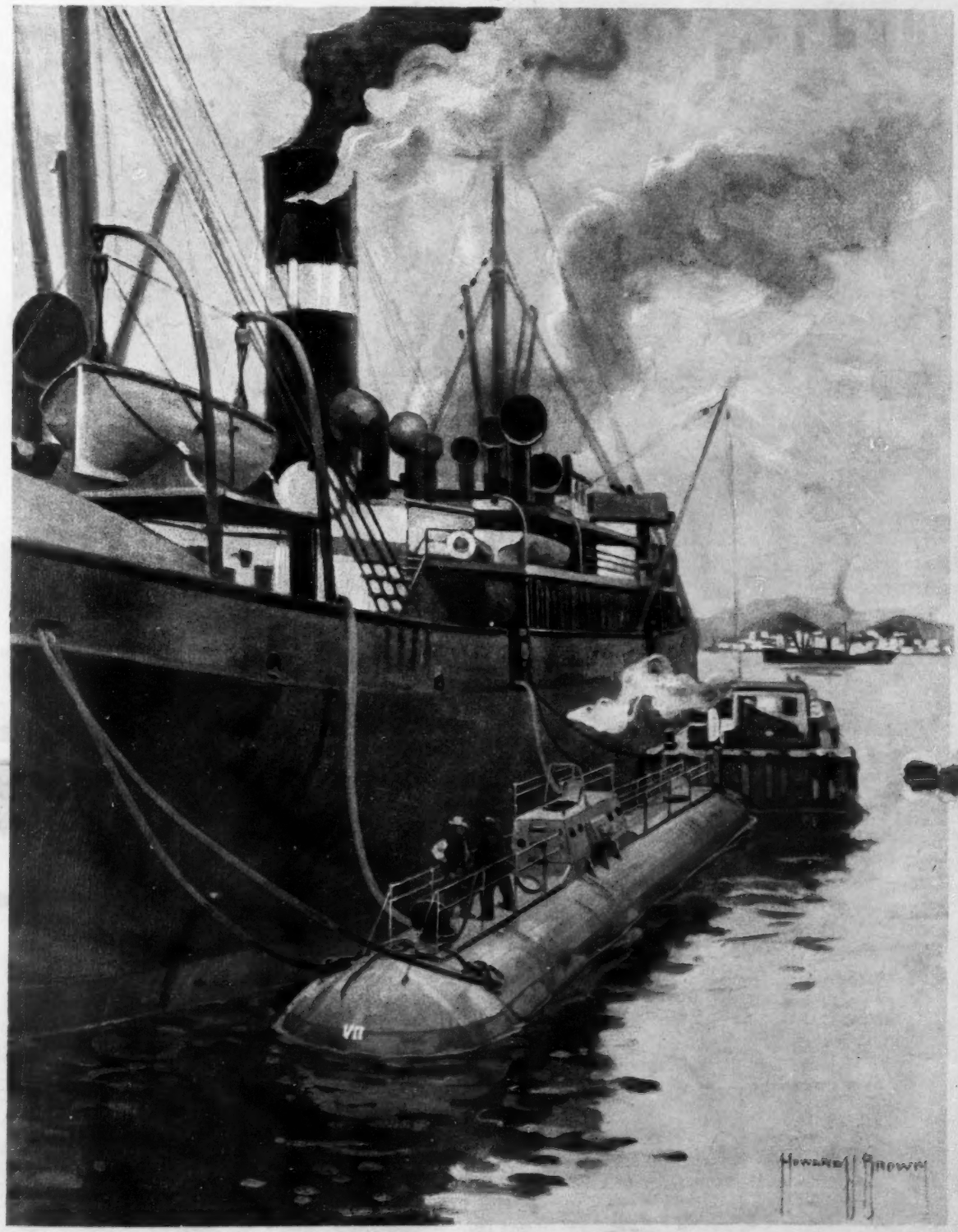

STEAMER TAKING OIL FROM AN OIL STORAGE CRAFT DEVELOPED IN ENGLAND [See page 226]

Vol. CXX. No. 10
March 8, 1919

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DIAMOND T
THE NATION'S FREIGHT CAR
IN MECHANICAL CONSTRUCTION the Diamond T is the combination of sound automobile engineering principles and the best possible materials and human skill.
In performance, the Diamond T is daily proving these principles, materials and skill to be 100 per-cent efficient.
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Among the numerous users of SELDEN TRUCKS are many of the largest and oldest established business organizations in America.

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CHICAGO *for instance*

One to Five Ton Worm Drive Models. Write for full information.

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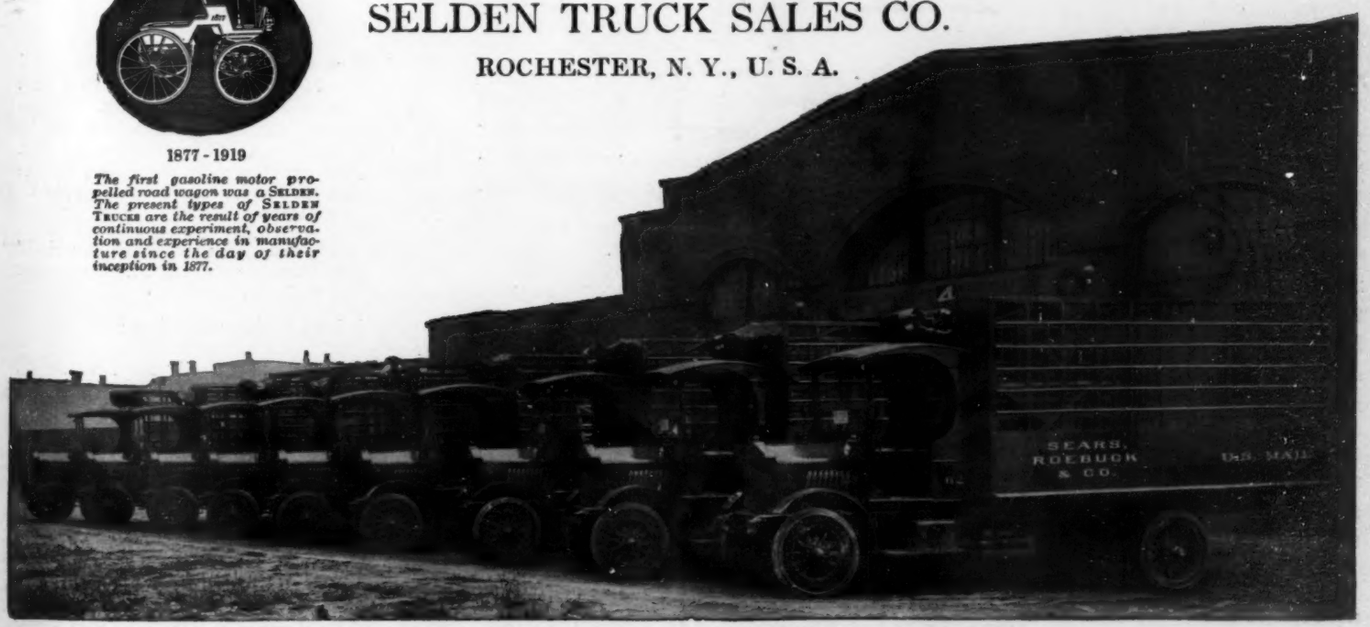
1877 - 1919

The first gasoline motor propelled road wagon was a SELDEN. *The present types of* SELDEN TRUCKS *are the result of years of continuous experiment, observation and experience in manufacture since the day of their inception in 1877.*



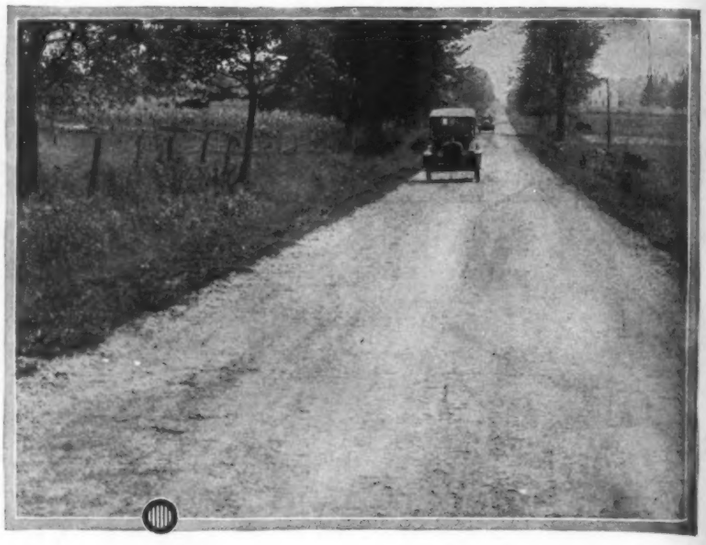
Trucks

Before

A typical view of West Michigan Pike, Van Buren County, Mich., before Tarvia was used.

Tarvia

Preserves Roads Prevents Dust



After

A view of the same section of the same road after Tarvia was used. Note smooth, dustless, easy-traction surface.

THE *"Before"* photograph above shows a section of West Michigan Pike, Van Buren County, Michigan, as it looked in the summer of 1916.

But the taxpayers of Van Buren County realized that such roads as this not only hampered the development of the county and made travel difficult, but that in the long run they *cost the community more than good easy-traction roads.*

The *"After"* picture shows the same road, photographed at exactly the same spot, after macadamizing and treating with "Tarvia-B."

West Michigan Pike is now a firm, mudless, dustless road, water-proof and automobile proof, over which full loads can be hauled to market with speed and economy.

And wisely, the taxpayers of Van Buren County propose to *keep* this road new. Last year they gave it a second treatment with "Tarvia-B." Thus at very small expense they protected their original investment and now have a fine piece of highway that brings their markets at South Haven and Watervliet miles nearer to each other.

The satisfaction felt over the vast improvement effected by the use of Tarvia is officially expressed in the following letter from the engineer of the Van Buren County Road Commissioners, Paw Paw, Michigan:

"The Van Buren County Road Commission has been using 'Tarvia-B' for some years to maintain about 20 miles of macadam road and it has given the greatest satisfaction. We have entirely got rid of dust and ravelling and it is the opinion of many observers that the roads get better instead of worse. This year we had about two miles of macadam which was so bad that the State Highway Department advised covering it with gravel, but instead we patched the holes with 'Tarvia-KP' (which by the way is something that is indispensable in our business) and treated the surface with 'Tarvia-B' and stone chips and today the road is in better shape than when new. We also have been trying out 'Tarvia-B' on a trunk line gravel road, the gravel testing about 75% stone. The results have been very good in spite of the heavy traffic. It produces a smooth, durable surface which will be better the second and third year than the first. We are now building a 30,000 gallon storage tank so that we can always have a supply on hand when we want it.

"Aside from treating the roads with 'Tarvia-B' there is no maintenance cost but a little attention to holes and drainage.

"Tarvia has solved our macadam road troubles for us.

"Dana P. Smith, *County Road Engineer.*"

Now that the war is over, the Nation needs more roads of this character properly maintained, because the public highways offer the only means of helping out the railroads and aiding our transportation facilities.

The use of Tarvia will give any community or state all-the-year-round roads that are dustless in summer, mudless in spring and fall, frost-proof in winter, and that are easy to maintain at a low cost.

Illustrated booklet describing the various Tarvia treatments free on request.

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SEVENTY-FIFTH YEAR

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THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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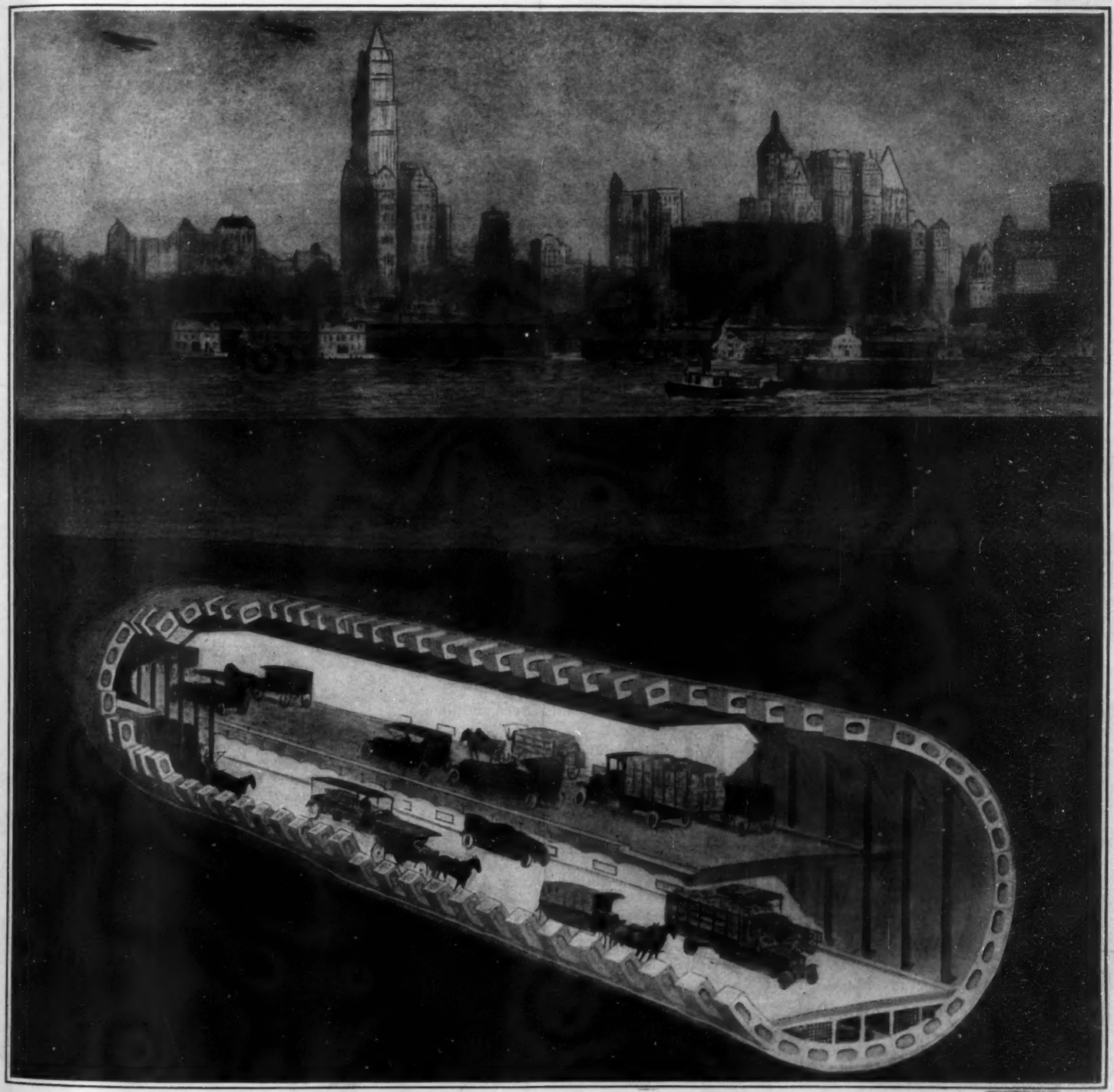

Proposed vehicular tunnel under the Hudson river—a double-decked structure providing for three lines of traffic on each roadway [See page 222]

SCIENTIFIC AMERICAN

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns especially when such articles are accompanied by photographs

Daylight Saving and the Farmer

WHEN we were informed that a rider had been attached to the Agricultural Appropriation Bill aimed to kill the Daylight Saving Act, we experienced a distinct shock. It did not seem possible after having thoroughly tested out the benefits of daylight saving last year, that anyone could be so reactionary as to wish to return to the former condition of wasted morning light. When we learned that the opposition to daylight saving was mainly due to the farmers, our astonishment grew apace. We had always looked upon the farmer as one who delighted in early hours and who would love to have the rest of the world routed out of bed with the sun. And so in our perplexity we hunted up a farmer friend and besought him for an explanation. His reply was surprising to say the least. He informed us that farmers really prefer the afternoon to the morning for work in the fields. They do rise early, to be sure, but the early morning work is taken up with chores. Much of the field work cannot be done until after the dew is off the ground. For instance, hay cannot be cut while it is wet with dew; the farmer must wait until the sun has dried off the moisture. Weeding also is done better when the scorching sun is high and when the weeds will wither immediately upon being pulled out of the ground. Weeds that are wet with dew may actually take root again, unless they are promptly withered by the sun. Last year farmers had difficulty with hired men who insisted on quitting work according to the new summer time, thereby cutting off an hour from the afternoon labors in the field. And strange to say the cattle did not take kindly to the new hour. The cows stubbornly refused to come home, when the sun was high in the skies, and as hired hands refused to wait upon the whims of the cow, the farmer was in a quandary indeed.

However, the advantages of daylight saving to the rest of the country are so marked that we cannot possibly wish to go back to the old time schedule, even if it may inconvenience the farmer to some extent. Not only did the general public find it much pleasanter to rise earlier and have more daylight leisure time after working hours, but there was an actual saving in lighting bills and consequently a saving of coal, which we cannot afford to ignore.

As for the cows we cannot expect to please them with any time schedule that is not based on the setting of the sun. No doubt they would love to have us use the Turkish plan of setting our clocks to 12 each day at the boom of the sunset gun.

But we may reassure the farmer that conditions this year will not be so bad as they were last year, for with our boys returning from the other side and with many hands idle during the reconstruction period, it will not be so difficult for him to obtain labor which will be willing to adapt itself to the conditions which the farmer has to meet.

By all means, let us continue to save daylight.

The Declining Supply of Motor Fuel

IT is almost superfluous to call attention to the ever increasing demand for gasoline; every motorist has it brought vividly before him every time he stops at a service station. It may not be generally realized, however, that the consumption of liquid fuel is now proceeding at such a rate that an estimate can actually be made as to when exhaustion will be attained if there is no improvement in supply or in use. As our knowledge of our underground resources becomes more accurate, it becomes correspondingly possible to reduce the margin of error in what once were mere scientific guesses; so that today we cannot afford to scoff at the technical man who tells us that there is in the United States, a mere 6½ billion barrles of petroleum underground. The annual consumption at present exceeds one-third billion barrels; and it requires no extraordinary mathematical ability to divide 6½ by ⅓, and get a quotient of 19½. Less than 20 years supply in sight, if present practice is maintained.

Today we get back about 20 per cent of our crude oil in the form of gasoline. This percentage can of course be increased, but not without increasing the cost. Nor must we forget that the stock remaining in the ground becomes heavier all the time, so that the yield of gasoline is bound to decline from this reason, until finally we shall be able to extract but 2½ per cent of gasoline from the crude product of our oil wells. The blending of high-volatile gasoline from natural gas with low-volatile gasoline from petroleum can be carried out, obviously, only so long as we have the high-volatile material to use in this way. This, with equal obviousness, will not be for long; nor can we, even now, get any great quantity of high grade fuel in this way.

By lowering the volatility of the gasoline, through the use of a larger percentage of the volatile petroleum, the supply of engine fuel can be increased, but not indefinitely nor without disadvantage. In particular, when we get fuel standards down to a point at which existing engines balk, what are we to with the millions of existing engines? Substitute fuels, such as benzol, alcohol, etc., may well be considered; but their price would necessarily be greater than that of gasoline today. Nor would it be possible to manufacture many of them on any scale without a complete overturning of a wide industrial field. The degree of interdependence existing in the very nature of things among the various trades using and manufacturing chemicals has been sufficiently emphasized by our wartime troubles with potash and nitrates and dyes. Finally, as we expect to show in an early issue, the oil shale deposits upon which so much reliance is placed for an extension of the gasoline supply to an indefinite period, are not going to be of such immediate or such wide effect as the public has been allowed to suppose.

The automotive industry can no longer afford to ignore the engine-fuel problem. The supply will positively decline, and the price will positively soar. The burden falls upon the engine. It must adapt itself to less volatile fuel, and it must be made to burn fuel with less waste. To accomplish these results is the task before the automotive engineers, who must turn their thoughts away from questions of speed and weight per horse-power and comfort and endurance, to avert what in the absence of effective attack will turn out to be a calamity seriously disorganizing an indispensable system of transportation.

Coal—Black, White, Green and Blue

MOST of us are familiar with the use of the term "white coal" to designate the power derived from streams. In Europe a distinction is made between white and green coal. Only the power derived from melting glaciers and snow caps is known as white coal, while other water powers are termed "green coal." But there is another vast source of power, namely, that which may be derived from the waves and tides of the ocean; and this is now termed "blue coal."

In a recent issue of the SCIENTIFIC AMERICAN we discussed the world's visible supply of black coal and showed that at estimated future rates of consumption, it could not last more than fifteen hundred years. "White coal" furnishes a virtually perpetual supply of power, but the quantity is limited. If we used all the available water power of this country, it would yield about sixty million horse-power, according to estimates of the U. S. Geological Survey. But much of this would not be commercially available as it represents the entire fall of all our streams. Forty millions is a more conservative estimate and this is the equivalent of three hundred million tons of coal. Vast as this total may seem, it would not begin to meet even our present needs, for we are consuming today about five hundred million tons of coal. In time we shall be compelled to supplement our hydraulic powers with other stores of energy.

"Blue coal," by far the greatest store of energy on earth, has as yet been practically untouched. There are enormous difficulties in the way of harnessing the ocean. It is so irascible and when angered its fury is so violent that as yet no man-made wave-power plants have been able to stand up against its wild assaults.

But we are growing more powerful every day. Engineering projects are being undertaken which only a few years ago would have been thought impossible. The time may come when even the ocean tempest will obey the will of man and turn its energies to useful work. More immediate, however, are the prospects of using the power of ocean tides. The subject is discussed at length in the current SUPPLEMENT. So far, such little power as has been abstracted from ocean tides has been insignificant. The rise and fall of the tides is not very great, even though it does amount to seventy feet in some few places, and hence, if any considerable power is to be obtained, basins of large area must be used. By damming the bay of Mont St. Michel in France, where the tide rises about forty-five feet, it is estimated that enough power may be obtained to operate half of the industries of France. A French engineer with vast powers of imagination has conceived of building dikes across the channel and across the Thames estuary to form two large tidal basins which may be used alternately to furnish a continuous supply of power. An ambitious plan, to say the least, but history teaches us that the visionary scheme of today often turns out to be the practical commercial enterprise of tomorrow.

Papers for the Soldiers

THE various official and semi-official bodies which are concerned with the supply of reading matter for the Army have with complete unanimity written to call our attention to the fact that at this time, when magazines are needed more than ever, the SCIENTIFIC AMERICAN is not reaching the soldiers in sufficient quantities; and the reason for this is pointed out.

When we changed our dress at the beginning of the year, we searched in vain for a place on our redrawn and smaller cover where the so-called "Burleson notice" would look well. We did not find such a place, and not realizing that the omission of the notice meant anything more than cessation in reminding our readers of something which they now know by heart, we decided to leave it off. But it appears that in the absence of the notice, the post offices refuse to forward copies of the paper mailed at the one-cent rate, and that there is accordingly a famine of SCIENTIFIC AMERICANS at the camps and hospitals here and abroad.

The SCIENTIFIC AMERICAN is in very great demand among the soldiers, and even normally it is difficult to make the copies received at the various army establishments go around. We are rather proud of the outcry that the Army has set up to have the missing notice restored, so that the SCIENTIFIC AMERICAN will come again to the soldiers; and we should be very happy indeed to restore it, even if it looked far worse than it does. We urge all our readess who can by any possibility get along without the file of back numbers to avail themselves of the Burleson privilege and help supply the soldiers with SCIENTIFIC AMERICANS.

Publication Work of the Department of Commerce

THE Department of Commerce issued during the past fiscal year 1,141 daily, weekly, monthly, quarterly, annual, and special reports, the printing of which cost $300,000. These publications contained a total of 42,644 printed pages, and there were printed of them a total of 4,804,180 copies.

The free distribution of many of these publications is limited to well-defined public classes. This policy has resulted in a reduction of wasteful distribution. A statement issued by the Commerce Department shows that the Superintendent of Documents received $32,993 during the year from the sales of copies of its publications. In addition to the sales by the Superintendent of Documents, the Coast and Geodetic Survey received during the year $20,194.19 for copies of Coast Pilots, Tide Tables, and Charts.

Industrial Efficiency

Fewer Accidents Now and Why.—War conditions, by bringing large numbers of new and unskilled workers into industry, had in general the effect of increasing considerably the number of industrial accidents, both actually and relatively to the number of persons engaged in certain industries. Information recently received by the Inspection and Investigation Service, Department of Labor, indicates, however, that in general the number of such accidents has now returned to approximately normal figures. In a comparatively short time before the entrance of America into the war, the effect of workmen's compensation laws and safety work had reduced the number of industrial accidents almost 50 per cent. The temporary increase due to the influx of war workers has now vanished.

Big Forestry Scheme for France.—Norway intends to help out the restoration of the devastated part of France, in the front zone, by planting a belt of Norwegian forest trees. Much enthusiasm has developed for the scheme, and it is intended to begin work this spring. It comprises the planting of 250 acres annually, for five years, and the money is streaming into Consul Heiberg, at Christiania. The idea is to send a forestry party of about 50 Norwegians, fully equipped with trees, tools, tents, and stores, so as not to impose the slightest burden on France. The tentative zone for planting the belt of trees is from Adrennes toward the Belgium frontier, behind Arras, where there formerly was fine forest; but action will be taken in accordance with the desires of the French.

Nonacknowledgement of Orders by American Firms.—The attention of the Monterey (Mexico) Consulate has been called to the difficulty that local firms are experiencing in securing acknowledgements of orders sent by them to the United States. This is a condition which was prevalent prior to the war, but with the added difficulties of trade incident to present conditions, the situation has been very much intensified. It appears that firms here send orders to the United States and get no replies for several weeks or months, and in some cases numerous telegrams are sent without any replies being received. Frankly, this is not the way to handle foreign trade. Such methods may yet cause American firms to lose much of the overseas business that has fallen into their hands during the period of the war.

Dead Sea Bitumen.—It is not generally known that ample quantities of bitumen occur in the Dead Sea region. It can easily be gathered and prepared for use in road making, and there is the advantage that it will be obtainable at much cheaper rates than those which now obtain in the Near East and in Europe. The material can best be applied by means of the usual tar-spraying machine. Dead Sea bitumen was undoubtedly used in ancient times. It is evident that the walls of the temples and palaces of Babylon and Nineveh were joined with bituminous cements, and there are bituminous cisterns in Syria of great antiquity which are still watertight and fit for use. A road surface treated with this asphalt according to modern methods may prove a most satisfactory solution of a very troublesome problem in the Near East, where, because of climatic conditions and the narrow wheels of vehicles, the macadam road is often a source of trouble, owing to the dust that rises from it.

Safety Engineering.—Safety work will be introduced in the curriculum of every technical school in the country, if possible, by the Working Conditions Service of the Department of Labor, as a means of promoting its plans for safety in industry. It is not planned to introduce special courses on safety work, but rather to inculcate principles of safety in connection with the usual instruction in engineering courses. The prevention of industrial accidents will mean a great economic gain to the Nation, for the annual loss in labor power is tremendous. Recently figures were given to show that 300,000 industrial accidents occur each year in Pennsylvania alone, these accidents including only those which required absence from work. The training of technical men in such a way as to keep safety principles before them in their work in factories, engineering projects, mines, and the like will be an important factor, it is expected, in reducing the present heavy drain on industry from accidents.

Science

Fire-Retarding Paints.—From tests made at the Bureau of Standards it appears that, while practically all paint coatings have some fire-retarding action, none of those so far tested afford very great protection. All the samples in question were materially damaged by application of flame for a few seconds. Both sodium silicate and whitewash rank comparatively high. These have the advantage of cheapness and can both be used on the same surface. However, according to a recent bulletin of the Bureau, no treatment of wood after erection can be expected to serve as an effective fire protection, and the use of such materials should not be made an excuse for omitting any of the usual precautions against fire.

Magnetic Analysis of Steel.—The U. S. Bureau of Standards has been engaged for some years in developing methods and apparatus for using the magnetic properties of materials as an indication of their quality and mechanical properties. A forthcoming paper deals with the magnetic properties which might serve as criteria for the estimation of the mechanical fitness of steel, describes magnetic methods of testing, and discusses the relation between heat treatment of high-carbon steel and its magnetic properties. The Bureau has applied the method of "magnetic analysis" to the testing of rifle-barrel steel, ball-bearing races and steel cable. These investigations are of especial interest in view of the recent development of the permeameter for working the measurements which the Bureau is now learning to translate into the ordinary terms of physical properties.

Wild Life Reservations in Michigan.—Mr. and Mrs. E. K. Warren, of Three Oaks, Mich., have just set aside as wild life preserves two tracts of land in Michigan. One is an area of 300 acres, near Three Oaks, consisting partly of virgin forest of beech and maple; the other, of 250 acres, is in the sand dune region on the shore of Lake Michigan, north of Sawyer, Berrien County. These preserves are incorporated in the "Edward K. Warren Foundation," which also includes the Chamberlain Memorial Museum at Three Oaks, opened in 1916. Both tracts have been set aside so that future generations may have an example of the primitive floral and faunal conditions of Southern Michigan, and as a place for carrying out various studies in natural history. The University of Michigan has been asked to make a detailed survey of the reservations and it is planned to extend this survey over an indefinite number of years. Field laboratories will be provided for this purpose by the Foundation.

Studying Sound at the Bureau of Standards.—A new branch of the U. S. Bureau of Standards, the Section of Sound Investigation, was organized in August, 1917, and has acquired a first-rate equipment, including the best types of instruments for determining the three distinguishing features of sounds; viz., pitch, intensity and quality. It has also a good assortment of sources of sound and standards of comparison. While the section has devoted much of its time to military problems, including studies in sound-ranging, etc., the apparatus acquired is practically all of it of permanent value for investigations of a general character. The Bureau has installed a Koenig clock fork, the most refined instrument yet constructed for the exact measurement of vibration frequencies of tuning forks. A Webster phonometer of the latest type, for measuring sound intensity, has been constructed for the use of the Bureau under the personal direction of Prof. Webster, of Clark University, Worcester, Mass. The Bureau has also secured an audion, as used in radiotelegraphy, and a large collection of tuning forks, including a unique and valuable set of 37 forks covering the range from 523 to 4,186 vibrations per second by semitones, specially made for the Bureau by a Chicago manufacturer. At the Bureau itself has been developed a set of "Reed phonometers," similar in principle to Webster's phonometer, but very much simplified and used in considerable numbers, so as to give data for a number of pitches at once instead of only one. For rapid but less accurate determination of the quality of a sound a simplified form of "phonodeik" has been devised. Both the Reed phonometer and the phonodeik have been used in testing the efficiency of several types of muffler for gasoline engines used in aviation.

Automobile

Airplane Type Engines for Pleasure Cars.—Although the regular airplane engine apparently has no place in the automobile field, the experience with some types of these motors has led to some interesting proposals in England. One type of motor that has been successfully developed abroad for flying machines is the "radial" engine, in which the cylinders, set radially around a common crank case, are fixed, and the crank shaft is driven in the regular way. Several British manufacturers are proposing to build moderate powered engines of this type, specially designed and built for use in light cars. One of these is described as having five air cooled cylinders of 63 mm. bore and 80 mm. stroke that will develop about 20 horse-power at 2,500 revolutions. This makes a remarkably neat and compact power plant, and if successful may be widely copied.

A Starting Trouble.—As time passes, and "gasoline" gets poorer, difficulties in starting the engine increase. Of course a large percentage of motor cars are equipped with electric starting devices, still it is not a reasonable proceeding to overwork an expensive battery to offset defective conditions. We cannot control the quality of our motor fuel, so it behooves us to give closer attention to the mechanical details that are apt to cause difficult starting. One of these, which often gives a great deal of trouble, because it is particularly elusive in its symptoms, is a leaking joint in an intake manifold. One of the commonest indications of this defect—that manifests itself after the engine has finally consented to start—is a sputtering that sometimes casts suspicion on the ignition, and then on the carbureter, and these manifestations are not always continuous, but decidedly spasmodic. Then it is well to go slow on adjustments, and look for leaking joints and sticking valves.

"After the War" Engines.—There has been much talk about the wonderful engines that are to appear "after the war," but, as has been noted, there is little likelihood that anything embodying notable changes will be seen for some months to come, for the reason that manufacturers have been too busy in other directions to develop new designs, and present models have stood the most exhaustive tests in the strenuous war work "over there," which would not indicate any very great necessity for a change just now. Still, evolution of the internal combustion motor may be expected to continue in its natural course, and not a few engineers have dreams of future engines of wonderful economy and efficiency. At a meeting of automobile engineers not long ago one of them said: "The internal combustion engine is understood in general, but in fuel and efficiency problems special attention must be focused on it. Our engines are not efficient. We must design engines that will use fuel more economically and not throw away 40 per cent of its thermal efficiency through the water jackets and 30 per cent through the exhaust, as is done today." It would greatly interest many of us to have some definite suggestions as to how these things are to be effected.

Airplane Engines in Automobiles.—A great many people are telling how the stock of airplane engines that has accumulated during the war can be utilized for pleasure cars, but their suggestions disclose a decided lack of knowledge of the characteristics of the motors in question. There are a great many reasons why such a use of these engines is not practical, but only a few of them will be mentioned here. A very desirable feature in an automobile engine is flexibility, which is practically non existant in the airplane type. It is true the automobile is equipped with change gears, but few people, even the most enthusiastic would care to run a very powerful motor at full speed all the time. Then again, the airplane engine is very lightly and delicately built, and it is expected, and usually necessary to carefully overhaul and adjust after every trip; and no amateur, and very few garage mechanics, are competent to perform this work. The period of their maximum efficiency is also very limited. Moreover, the exceedingly light construction of the flying engine makes it inevitable that it would fail at many points, and in a very short time, as a result of the jolting it would be subjected to in a car. As a last reason, even the smallest engine would be altogether too powerful for the suggested work, and the man who took one of them out on a public highway ought to be indicted on sight, as there is no reasonable occasion for an engine of from 100 to 400 horse-power, and a car with such a motor would be a menace to the community.

The Proposed Vehicular Tunnel Under the Hudson River

A Study in Ventilation

THE Hudson River is at once a valuable asset and a serious handicap to the city of New York. It provides an unexcelled waterway up the entire length of Manhattan Island, and at the same time, its depth and broad expanse make it a difficult river to span with bridges. Except for the three railroad tunnels that have been pushed through its bed, the only means of travel between the metropolis and cities on the Jersey shore, is by ferry. The inadequacy of this means of communication was clearly demonstrated during the war and the recent ferry strike emphasized the importance of establishing a roadway either above or below the river which could be used by trucks or passenger vehicles.

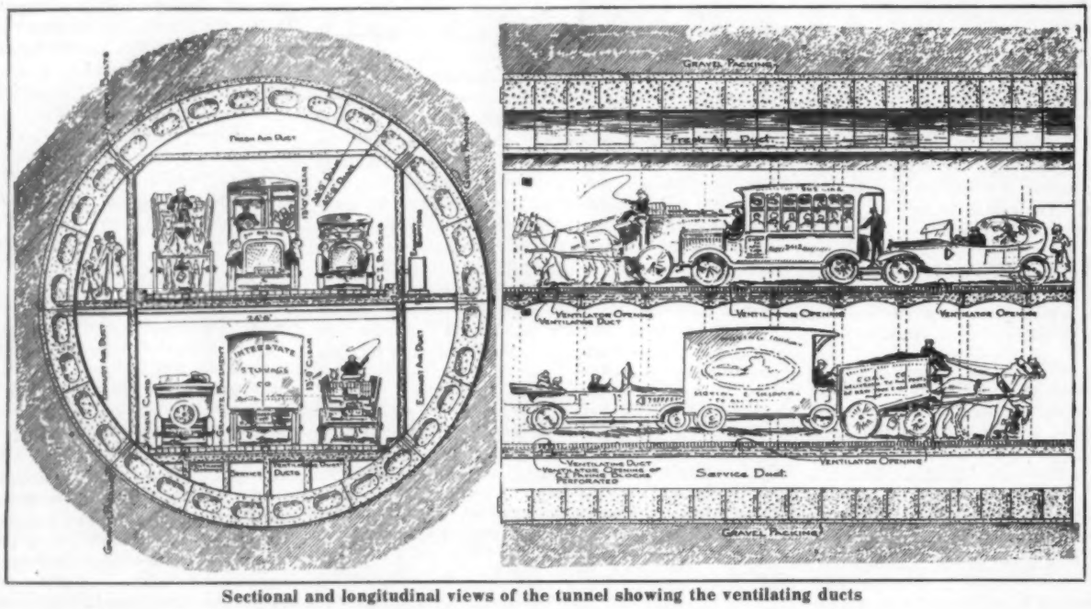
Our ferries have not sufficient capacity to accommodate the wheeled traffic that plies between New York and Jersey City. On almost any afternoon long lines of motor trucks and passenger cars may be seen waiting their turn to get aboard. Frequently a car must await the loading of three or more ferries before room will be found for it to be taken aboard. Clearly something should be done and done at once.

Eighteen months ago a letter was published in the correspondence page of the SCIENTIFIC AMERICAN severely criticizing a proposed vehicular tunnel under the Hudson River on the ground of inadequate ventilation. It was shown that the exhaust gasses of an automobile contain considerable quantities of carbon monoxide —a most insidious and deadly poison which is injurious even when present in quantities of six or seven parts of gas in 10,000 parts of air,—and the correspondent stated that to dilute the gases sufficiently to insure the safety of motor travel through the tunnel under normal traffic conditions, would call for the use of 48,000 horse-power for the ventilation system alone and at an annual cost of $50 per horse-power this would amount to $2,400,000!

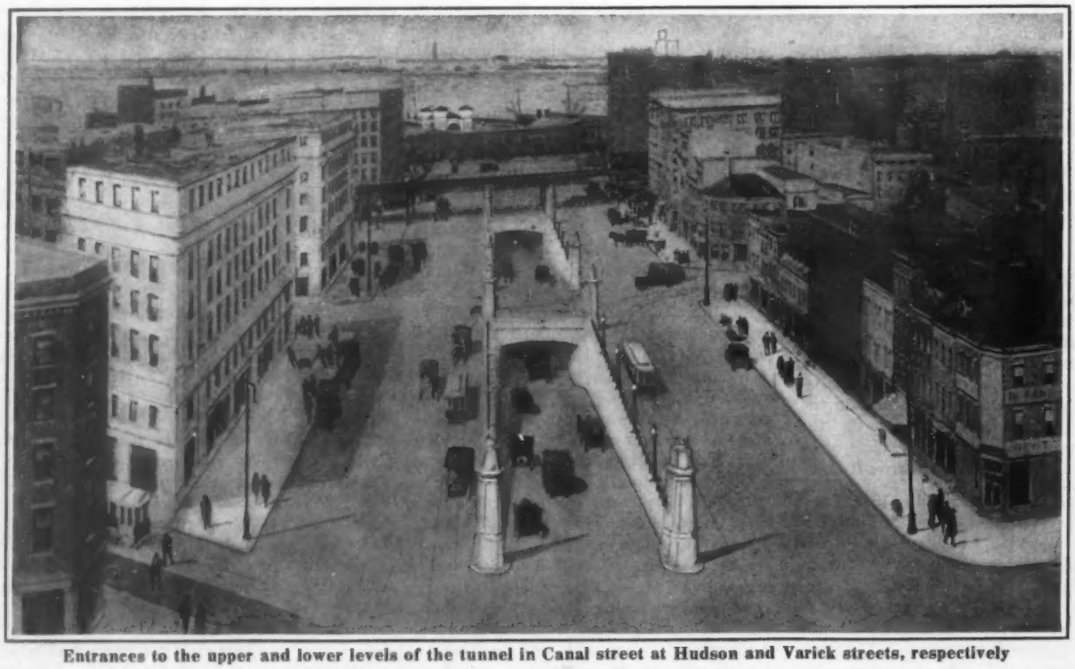
Although we do not hold ourselves responsible for statements made in the correspondence page, nevertheless the conclusions reached in this communication were of so startling a nature that we checked up very carefully the data on which the argument was based and could find no serious flaw in it. Accordingly the criticism received our unqualified support and we supplemented the letter with an editorial vigorously condemning the construction of this tunnel for motor vehicle traffic.

But our criticism applied only to the particular tunnel then prominently before the public and it must be revised considerably when dealing with the tunnel recommended by General George W. Goethals, in his capacity of consulting engineer for the New York State Bridge and Tunnel Commission. The former tunnel was elliptical in cross-section with a horizontal diameter of 32½ feet and a vertical diameter of 22½ feet. There was no division between east and west traffic and no means of making the air currents flow in the direction of the streams of traffic. The tunnel measured 5,500 feet between shafts and had a cross-sectional area of 575 feet or a total content of 2,160,000 cubic feet. To ventilate the tunnel, a duct was provided with a cross-sectional area of but 52 square feet and through this duct air would have to be driven at a rate of 160 miles per hour, in order to provide sufficient dilution of the carbon monoxide produced by a conservatively estimated density of traffic.

General Goethals' tunnel is a very different design. A perspective view of it is given in our frontispiece and the accompanying views show it in longitudinal and cross-section. It consists of a tube 42 feet in diameter, built of pre-cast concrete blocks, three feet thick, so that the inside diameter of the tube is 36 feet. A central horizontal diaphragm separates the tunnel into a lower west bound and an upper east bound roadway. The roadways are 24 feet 6 inches wide and with 13 feet of head room they provide room for three lines of traffic on each roadway. Slow horse-drawn trucks must keep to the right, motor trucks must hold the center line and high speed passenger cars the extreme left. In this way the capacity is increased nine fold over the capacity of a tunnel with but one line of traffic.



Sectional and longitudinal views of the tunnel showing the ventilating ducts



Entrances to the upper and lower levels of the tunnel in Canal street at Hudson and Varick streets, respectively

Although a 42-foot bore calls for a much larger pneumatic shield than has ever before been used in tunnel work there are no apparent engineering difficulties in the way of its success. The use of concrete blocks in place of a cast iron lining is somewhat unusual but it is not an untried experiment. The Mount Royal tunnel at Montreal was built of such blocks, with perfect success. From a tunnel engineer's point of view the plans are feasible. The only problem is that of ventilation. Can the tunnel be cleared of poisonous gasses without running into prohibitive figures for the installation and maintenance of an adequate ventilation plant? We have consulted an experienced ventilation engineer and he assures us that it is perfectly feasible. Above the roof of the upper deck and the side walls of the two decks are large ventilation ducts. Since our cuts were made the design of the tunnel has been slightly modified and the horizontal partition beyond the side walls (as shown in the sectional view) have been eliminated making the total cross-sectional area of the air ducts 250 square feet. In the former tunnel it will be recalled that the duct area was but 52 square feet. The significance of this lies in the fact that the power required to drive a given quantity of air through a duct varies *inversely* as the *cube* of the opening.

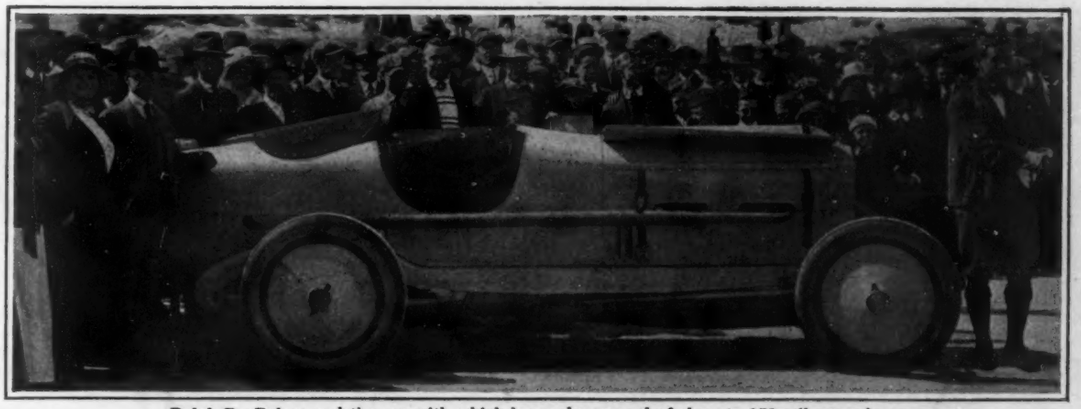
Provision is made in this tunnel for two large ventilating towers just inside the pier-head at either side of the river. These ventilating shafts will be 4,000 feet apart as against 5,500 feet in the old tunnel. With two lines of cars spaced 60 feet apart on centers there would be 130 cars between towers on each deck. But it is believed that 100 cars between towers and 100 more on the ramps

would more nearly represent average traffic conditions. If each car exhausts 86 cubic feet of gas per minute we shall have a total of 8,600 cubic feet of gas discharged in the tunnel each minute between the ventilating towers. Twelve per cent of this gas or 1,040 cubic feet is carbon dioxide and three per cent or 258 cubic feet is carbon monoxide. As CO_2 is denser than air being .123 as against .08 our 1,040 cubic feet of CO_2 reduces to 680 cubic feet. To render CO_2 non-injurious it must be diluted in the proportion of 50 parts to 10,000, hence it will take 136,000 cubic feet of air to take care of the carbon dioxide.

According to the original letter published in the SCIENTIFIC AMERICAN, an authority was quoted for the statement that six parts of CO in 10,000 brings on suffocation in 47 minutes. Other authorities are much more liberal and our ventilation engineer assumes that by diluting the carbon monoxide to 6.5 parts in 10,000 it will be rendered non-injurious. To produce this dilution the 258 cubic feet of CO must be mixed with 400,000 cubic feet of air or a total of 536,000 cubic feet for the dilution of both the CO_2 and the CO, and this must be supplied each minute for each deck of the tunnel. This means 26 complete changes of air in the tunnel per hour or one every 2.3 minutes. As there is 125 square feet of duct area for each deck the velocity of air in the duct amounts to 2,140 feet per minute or a velocity of less than 25 miles per hour. This would require approximately 17,000 horse-power and the yearly demand of 5,000,000 horse-power hours at one cent per horse-power hour would amount to the moderate sum of $50,000.

Twenty-six changes of air per hour represents a very active air circulation. The air moves in the direction of traffic and is distributed in each 2,000 feet of tunnel. Fire doors are provided at close intervals with fusible links so that in case of fire the door will be released and the whole duct area will be opened to the tunnel at the point of the fire, exhausting a large quantity of air. The moving vehicles would to a certain extent act as pistons and aid the circulation of air in the direction of traffic, whereas, under the older plan of a single tube for two-way traffic there would be rather interference with circulation than aid thereto.

Ventilation engineering is a very exact science and apparently there is no reason why a traffic tunnel may not be built in which pure air may be maintained provided the matter is given adequate consideration by experienced ventilation engineers.



Ralph De Palma and the car with which he made a speed of close to 150 miles per hour

150 Miles Per Hour on Wheels

IT was only a short time ago that we could scarcely believe our eyes when we read that an automobile had made a speed of 120 miles per hour, or a mile in half a minute. Since then, mile records have been successively smashed. With the advent of the airplane we grew quite accustomed to think of travel at speeds of 125 to 150 miles per hour; and so when we learned that Ralph de Palma, racing at Ormond Beach, on Lincoln's Birthday, had made a mile in 24.04 seconds, we were not half as astonished as we really should have been. This figures out to nearly 150 miles per hour, or 149.8, to be exact. Few airplanes have made as high a speed as this against the air. To be sure, with a following wind to help them, they have exceeded this speed as measured over ground, but 150 miles per hour without the aid of drift is an exceedingly high velocity and it is truly remarkable that we should be able to make as high a speed on wheels as on wings. The car with which the record was smashed has a twin-six aviation engine power plant. The former record for the mile was 25.4 seconds. Following the Lincoln's Birthday performance, Ralph de Palma made some other interesting records. The mile from a standing start was made in 38.83 seconds as against a previous record of 40 seconds, and two miles were made in 49.54 seconds as against 51.28 seconds. The records with flying start for two miles, five miles, 10 miles and 20 miles, were 49.54 seconds; two minutes, 4.58 seconds; four minutes, 9.3 seconds; and eight minutes, 54.2 seconds respectively.

American Substitutes for Boxwood

THE amount of genuine (Turkish, Persian, Corsican, or English) boxwood imported into this country has been reduced to such an extent that the price is almost prohibitive. Often the old-world boxwood cannot be obtained in the open market, and manufacturers of wood-engravers' blocks, draftsmen's scales, chessmen, roller-skate wheels, small handles, and certain kinds of novelties are looking for woods that can be used as substitutes. No wood is known which in all respects is the equal of boxwood for the more exacting uses, especially for engraving blocks for printers. It is, however, the opinion of the Forest Products Laboratory at Madison, Wis., that certain native fine-textured woods can be used to a large extent for some of the purposes for which boxwood is used.

The properties which have given boxwood its reputation and which must be found in a satisfactory substitute are a very fine and uniform texture, a fairly high degree of hardness—so that the wood will take a fine polish, will not wear away easily, and will work smoothly under tools—freedom from gums and resins, and a light, preferably yellowish, color.

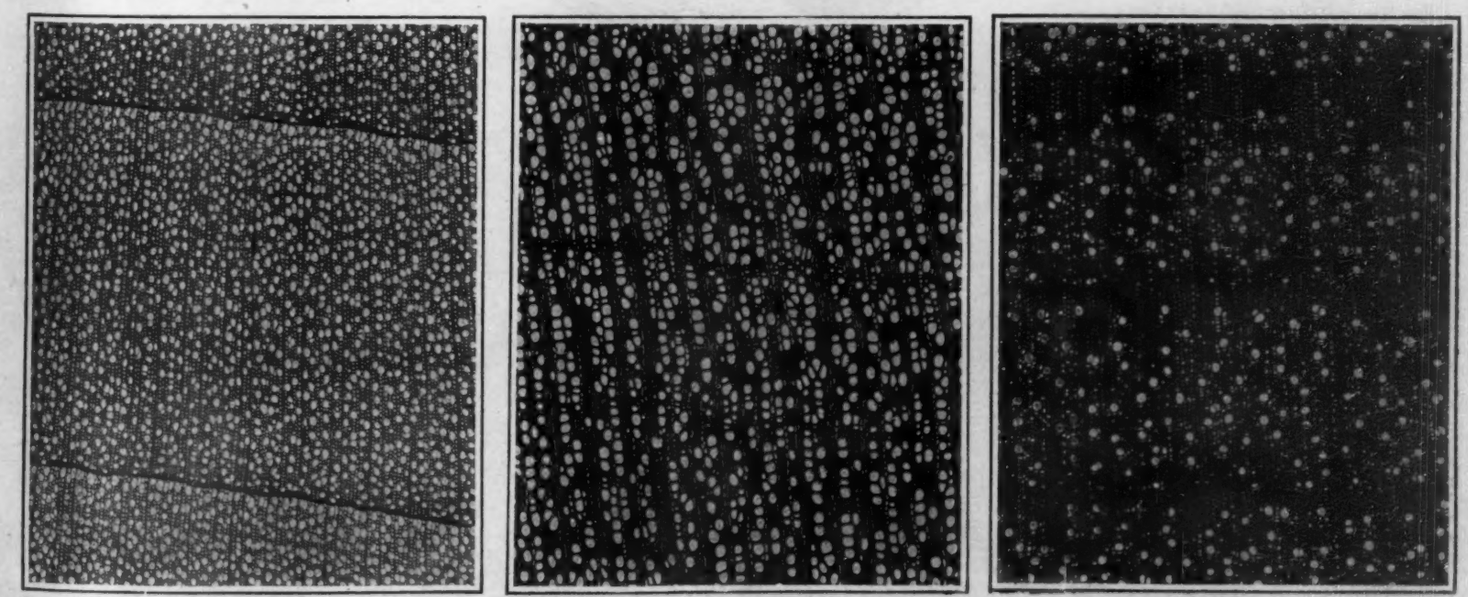
Among our native woods, only two species come anywhere near having all the properties of boxwood. These are Florida boxwood and wahoo, otherwise known as strawberry bush, or burning bush.

Florida boxwood, which grows abundantly in Florida and the West Indies, is a hard, yellowish wood of very uniform texture. Though it is somewhat coarser than true boxwood, a fact which would be a drawback to its use for the finest work, it is probably the best substitute, when availability is considered.

Wahoo grows in most of the wooded regions east of the Rocky Mountains, but attains the proportions of a tree only in southeastern Arkansas, eastern Texas and the Appalachian regions south of Pennsylvania. Its wood is not quite so hard as that of boxwood; but it has an even finer texture. Owing to the scarcity of merchantable material of this species, its value seems to be unappreciated. Trunks three or four inches in diameter would undoubtedly work up well into chessmen and rules, and larger sections could be used for engraving blocks. Owners of wahoo trees would do well to correspond with users of boxwood, with a view to utilising this valuable wood.

A few other native hardwoods have somewhat the same characteristics as boxwood and might be used for the less exacting forms of engraving or the manufacture of cheap rules and novelties. Among these are witch hazel, great rhododendron, mountain laurel, thornapple, orange wood, torchwood, mastic and yellow buckeye. Mastic and torchwood might be obtained in sufficient quantities in southern Florida to make their exploitation profitable. The citrus orchards of Florida and California furnish a considerable quantity of orange wood each year. Suffi-

(Continued on page 236)



Typical cross section of wahoo (left), Florida boxwood (center) and true boxwood. The average inside diameter of the pores is, respectively, .023mm., .036mm., and .027mm.

The Heavens in March, 1919

The Death of Professor Pickering, and Other News of the Month

By Professor Henry Norris Russell, Ph.D.

THE first duty of the astronomical chronicler this month is a sad one—to record the death, on February 3d, of Professor Edward C. Pickering, the distinguished Director of the Harvard College Observatory, and the dean of American astronomers. The 42 years of his service at Harvard cover practically the whole history of modern astrophysics, and in all this period of unexampled activity he was a moving spirit. When he began his work, the measurement of the brightness of the stars had hardly been more than touched, and the very definition of the scale of stellar magnitudes was still in debate. Only a few sporadic efforts had been made to photograph the stars, and practically all that was known of their spectra depended upon difficult and inaccurate visual observations with small telescopes.

In all these lines of fundamental investigation Harvard, under Professor Pickering, took the lead. The details of the scores of investigations which were carried to completion under his guidance fill nearly eighty volumes of the Harvard Annals. Not even the baldest summary of them would be possible here. Suffice it to say that the conclusion of his long term of work finds the Harvard scale of stellar magnitude, as defined by the measurements of more than forty thousand stars, accepted as the international standard: the Harvard Library of Photographs developed into a collection of about a quarter of a million plates—each a unique record, containing, in some instances, hundreds of thousands of individual facts regarding the stars: the Harvard Classification of stellar spectra, like the scale of magnitudes, adopted as the international standard; and the great New Draper Catalog, giving the spectra of about 220,000 stars, completed in manuscript and partly printed.

The expense of publishing the one volume of this last monumental work which has so far appeared was met by Professor Pickering himself—and the intense love of his work which is revealed by this was characteristic of the man. No one could have been more unselfishly devoted to his chosen calling, and he was always willing, to go out of his way to give any aid in his power to a colleague, whether by furnishing him with material from the great storehouse of the Harvard collection, or by bending his influence and wise advice in obtaining new instruments or funds for the enlargement of his work. His departure will leave a gap in scientific circles, both in America and abroad, which will be very hard to fill.

Our New Next-Door Neighbor in the Celestial Community

Turning from these memories to the news of the astronomical world, the discoveries that deserve most comment are told in a copy of the *Publications of the Astronomical Society of the Pacific*, which reached this part of the country only yesterday. One note of decided interest here deals with another near neighbor of our solar system—that is, near as the stars go. This is a tiny star between the twelfth and thirteenth magnitudes in brightness, which was picked up by van Maanen at the Mount Wilson Observatory in the latter part of 1917, upon plates taken in a search for a possible faint companion to a rapidly moving brighter star. Upon comparing photographs taken a couple of years apart, no such companion could be found; but one of the inconspicuous stars was found to have shifted its position very considerably, and to have the remarkably large proper motion of 3.01 seconds annually. This rapid motion, which is exceeded by only a score or so of stars, made it probable that the star was relatively near us in space.

Observations for parallax were promptly begun by the discoverer, and now, from 16 plates taken with the great Mount Wilson reflector, he finds the large value 0.244 second, with a probable error of only one-thirtieth of its amount. This means that the star is at a distance of about thirteen light years, and nearer than all but perhaps twenty of the millions of stars which appear to our eyes to be brighter. If it were not so very near us we could not see it at all; for it is one of the faintest objects of which we so far have knowledge, being only 1-6000 as bright as the sun. Even Barnard's recently discovered "runaway star" is two or three times as bright as this, and the only fainter star which is so far known is Innes's companion to Alpha Centauri.

The most curious thing about this newly discovered object, however, remains to be mentioned. Its spectrum is of type F, similar to that of Canopus, and indicates a higher surface temperature than that of the sun; and direct measures of the color show that it is also whiter than the sun, indicating again that it is hotter. But if it is hotter than the sun, it ought to shine more brightly per square mile, probably two or three times as brightly, at the least; and this would mean that its superficial area was less than 1-10,000 that of the sun, and that it was no bigger than the earth!

Now there is no doubt that a body the size of the earth, if it could be heated so that its outer atmosphere was at a temperature of some 8,000 degrees Centigrade, would be very similar to this tiny star in brightness, color and spectrum. But there is very good reason to doubt that so small a body could stay hot—to doubt that enough heat could be produced inside it to supply the loss by radiation from the surface.

At 11 o'clock: Mar. 8.
At 10½ o'clock: Mar. 16.
At 10 o'clock: Mar. 23.
At 9½ o'clock: March 29.
At 9 o'clock: Apl. 7.
At 8½ o'clock: Apl. 14.
At 8 o'clock: Apl. 22.

NIGHT SKY: MARCH AND APRIL

We know too little, however, of the sources of the heat which the stars radiate so fiercely into space to make it safe for us to dogmatize upon questions of possibility. All one can say is that either this newly discovered body is hardly larger than the earth, or else it is much larger but for some reason does not shine as brightly per square mile as might be supposed from its spectrum and color—leaving it to future investigation to solve the riddle.

A Double Star of Unusual Interest

A second communication of much interest, from Adams and Joy at Mount Wilson, deals with a number of new spectroscopic binary stars. One of these, known as TT Aurigae, is of unusual interest, for it has been known for years that it was double, on account of the variability of its light caused by the alternating eclipse of each star by the other. Now the spectroscopic observations confirm the duplicity, two spectra being visible, with lines at times so widely separated that they indicate a relative velocity of 450 kilometers per second. From the photometric observations it is known that the period is 32 hours. With the orbital velocity of 450 kilometers, this would mean that the stars were 8,300,000 kilometers apart, and that their combined mass was about twelve times that of the sun.

Now Shapley, from the photometric data, finds that the diameters of the two stars are respectively 61 and 52 per cent of the distance separating their centers. This leads to the estimate that the larger and brighter star is 5,000,000 kilometers in diameter, or about three and a half times that of the sun, while the fainter component is of just about three times the diameter of our orb of day.

Both stars show helium lines in their spectra, and are probably much brighter per square mile than the sun, so that it would be a reasonable guess that the combined brightness of the two is three or four hundred times as great as the sun's. As their combined light exceeds but little that of a ninth-magnitude star, the distance of the system must be very great, probably as much as 3,000 light years.

All these numerical estimates are provisional, and will soon be superseded by exact determinations; but there are so few stars for which the actual diameters are known that even these rough values are worth recording.

The Heavens

At our accustomed hour of watching, the splendid group of the winter constellations has swept far into the western skies. Canis Major, Orion and Taurus lie low along the southwestern and western horizon. Canis Minor, Gemini and Auriga are h gh above them, with the planet Jupiter adding to the brilliance of the second named. Leo is very high in the south, with Saturn as an added luminary. Hydra stretches its huge length below, with Crater and Corvus upon his back. Virgo and Bootes are well up in the southeast and east, and Hercules is rising in the northeast. Cassiopeia, Cepheus and Draco are low in the north, and the Great Bear rides high above the Pole.

The Planets

Mercury is an evening star all through March, and is well visible about the time of his greatest elongation, which occurs on the 21st. On this date he sets at 7.40 P. M. and, being 18 degrees from the sun and 9 degrees north of him, should be conspicuous, especially as he is unusually bright, exceeding Arcturus.

Venus, too, is an evening star, and is growing increasingly conspicuous. She remains in sight until 7.40 P. M. at the beginning of the month, and at its close does not set until 8.50. She is about 10 degrees higher in the sky than Mercury, when the latter is at his best, and should serve as an excellent guide in finding him.

Mars is likewise an evening star, but too low to be easly seen. On the 11th he is in conjunction with Mercury, and the two planets are only a degree apart; but it will take a good glass to pick Mars up in the twilight.

Jupiter is in Gemini, and is in quadrature east of the sun on the 28th. He is high in the sky all the evening, and does not set until well in the small hours.

Saturn is in Leo, and is admirably placed for observation, crossing the meridian at 10 P. M. in the middle of the month. Uranus is a morning star, in Aquarius, but is practically unobservable. Neptune is in Cancer, and observable telescopically till midnight, or later.

The moon is new at 6 A. M. on the 2d, in her first quarter at 10 P. M. on the 8th, full at 11 A. M. on the 16th, in her last quarter at 4 P. M. on the 24th, and new again at 4 P. M. on the 31st—the two new moons in this month making up for there being none in February. She is nearest the earth on the 4th, and farthest away on the 20th. During the month she is in conjunction with Uranus on the 1st, Mercury on the 2d, Mars on the 3d, Venus on the 4th, Jupiter on the 10th, Neptune on the 12th, Saturn on the 14th, and Uranus again on the 29th.

At 11 A. M. on the 21st the sun passes the celestial equator and, in almanac phrase, "Spring begins."

Princeton University Observatory.
February 18th, 1919.

Proposed British Bureau of Longitudes

The Royal Society has recommended the establishment of a body corresponding to the French Bureau des Longitudes, to which could be referred any administrative question involving consideration of time or position.

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

How Best to Make the Airplane Safe

To the Editor of the SCIENTIFIC AMERICAN:

There has been so much said about the application of parachutes to pilots and observers, and the subject has been given so much publicity in the announced parachute competition of the Aero Club of America, that a detailed, practical discussion of the practical value of the parachute on the airplane would be illuminating, alike to aviators and to the public.

Airplane accidents may be classified into three categories: those occurring at high altitude, those at low altitude (near landing) and those which are to be identified as fires. Of the three the second class furnishes the overwhelming majority of cases, for several reasons. The pilot on nearing the ground for landing is compelled to maintain a speed of about fifty miles per hour (varying somewhat according to the design of his machine); if by any miscalculation he falls materially below this speed, a crash to the ground is almost inevitable. Moreover, at such a speed and at such close quarters with the ground, a little variation of the angle of descent very often causes a nose-dive which there is not room to check before a crash comes, or perhaps a capsizing of the machine after touching the ground. With all these considerations foremost in his mind, the pilot must meet a third requirement; he must maintain correct horizontal balance during the approach to and the alighting upon the ground. In a forced landing, where the aviator is compelled to fly low around the limited area which he has picked for his landing, this is particularly trying.

It is obvious that in these cases a parachute would be of no avail; there would be neither time for it to be used, nor the height for it to open. With accidents at high altitude it appears at first as though the reverse were the case; and certainly we must admit that here the parachute will have sufficient drop to make it open. But such accidents are mainly due to loss of motive power; and ordinarily the pilot in such a situation saves both himself and his machine by skillful maneuvering. So true is this a pilot frequently shuts off his power purposely to dive at will; and his psychological tendency in an accident of any sort at a reasonable altitude is accordingly to sit tight and try to straighten out the machine. Besides, while diving accidentally at terrific speed he would have but little chance to extricate himself from his tiny cockpit and jump from the machine to take a chance for his life with a parachute—I say "take a chance with a parachute" because in the comparatively few tests made there have been cases where the parachute failed to open. For instance, this occurred to the unfortunate Leon Molas at Venice, Cal., on August 18th last, when he stepped from his plane to death at an altitude of 7,500 feet. Finally, even if the aviator got away from his machine and safely to earth in a parachute, there is always the possibility of fatality through the crash of the wild plane against other people or into a building.

A further cause of accidents would be by collision, which may cause, say the collapse of the motor. In this case the pilot could glide the machine safely to a landing, as he does when his engine goes dead from internal causes. Or if the wings had collapsed or the machine was a total wreck in some other respect, the speed of fall would be so terrific that the pilot would have no chance to unstrap himself and climb over his seat.

There remains the case of fire aloft. In this case, which may be more or less serious, the pilot may have the opportunity to use some extinguisher, as has actually been done in certain instances; or he may side-slip his machine so that the rush of air will blow out the fire. The only occasion where it would be really in order to consider jumping with a parachute would be in the event of a continuous fire in the motor, with the latter in front of the pilot. But the present tendency in planes is more and more toward a multiplicity of motors, mounted far from the pilot and other occupants.

With this catalog of the sources of accident before us, it is clear how very limited may be the practical utility of a parachute attached to the pilot. Upon long consideration of these reasons, especially those pertaining to low-altitude accidents near landing, which are by far the most frequent ones, I feel that the only means of adequately insuring safety on an airplane is a device that would save both the machine and its occupants. Such a device should be attached at the most suitable point, and must be within easy and immediate control of the pilot. It should consist of a collapsible frame covered with light fabric rendered fire-resisting. This member should be so formed that when fully developed it would form an emergency wing to engage the air in front and let it escape through the rear. Note that a parachute cannot do that on account of its spherical shape. The emergency wing or surface should be so designed as to stabilize itself automatically in flying position against any air pressure, no matter what the direction of fall. Such a device should have about one-fortieth the weight of the machine, and during flight the major part of its weight should be carried idle by the flow of air. The device should not offer much head resistance when inoperative—say, one-eighteenth the total resistance of the plane as a whole. It should be designed in such a way as also to act as a brake when required, especially in avoiding collision in close formation.

Low-altitude accidents would be avoided, especially those incidental to landing, by the same device acting to change automatically the angle of flight upward, causing the plane to lift its nose and arrest simultaneously its speed. It should give an airplane the same inherent stability that birds possess in landing—they will be noted to arrest their speed by curling their wings and tail, while simultaneously they throw their head upward and land on their feet. In other words, the airplane should follow nature as closely as possible.

It is obvious that we cannot expect in practice to turn the wing of an airplane to reduce its speed; but an adequate surface should be developed against the rush of air, with such a pulling resultant applied at such a point of the plane as to create a new rotating moment capable of adequately raising the nose of the machine at the moment of landing, while arresting its speed.

On the other hand, it is understood that an airplane could not carry a different safety device against each different type of accident. Hence the need for one good single device incorporated upon the machine with more or less the limitations of weight and air resistance that I have mentioned, and capable of such automatic movements, by the flow of air itself, as to cause at the easy and secure control of the pilot whatever new automatic combination of forces might be needed to render the plane more bird-like and afford the pilot and his companions incomparably more safety than a mere parachute.

GAETAN AJELLO.

New York.

Safety for the Standing Train

To the Editor of the SCIENTIFIC AMERICAN:

Referring to Mr. Buell's derail and signal to protect a workman, as pictured in the SCIENTIFIC AMERICAN of December 7th, why not, as suggested by another practical railroad man, employ the same means to protect a train? By the use of the derail and of another safeguard as readily applied, rear end collisions, the most dreaded and destructive of all train wrecks, might be always prevented, or come as near it as human means permit.

While all trains are protected in front by heavy locomotive, mail and express cars, the rear is exposed to complete destruction when a high speed projectile of a thousand tons perhaps, is hurled upon it at terrific speed. Occupants of rear cars on the best managed roads are in a sense always in danger, not merely to life and limb, but of death in its worst forms, by fire and steam, and there are those who never ride in rear coaches when others are available.

The suggestion is that all standing trains at stations be protected by turning a switch behind them, thus cutting them off from the line, permitting the following train, if out of control, to pass by on some other track, or in case none is provided to run off the switch and be derailed.

Out upon the line the derail would be employed to protect any train unexpectedly forced to delay. Carried always in the rear car, it could be seated at once upon the rail, where, in case the following train got by the flagman, it would throw it from the track. It would substitute an intentional wreck for an accidental one, a case of the greatest good to the greatest number, as where a building or a block is blown up by dynamite to save a much greater loss by fire.

I have before me the SCIENTIFIC AMERICAN of September 21st, 1912, with a list compiled by Mr. Fisher of Taunton, Mass., of the wrecks of "our fast trains" in four months, beginning with December, 1911. There were 18 of them. Eight were derailments, but by far the greater number of fatalities in proportion were caused by collisions, where trains ran by signals and struck standing trains. Within a month of this writing there have been four cases of this kind noted and all attended by loss of life. Apparently, had the standing train in every instance been protected by a switch or a derail, the loss of life would have been comparatively slight and of property much less.

A great general has said that in war nothing is left to chance. It should be as true of the transportation of human freight. On the Mt. Washington Railway, still the steepest in the world it is said, every precaution that ingenuity can devise is taken to prevent a runaway. But with trains following one another so closely on a level, with signals obscured by fog or storm, or overlooked by the tired or overstrained eyes of an engineer, there is nothing absolutely to protect the closely packed coaches, but isolating them from their pursuers on the same line of rails.

The greatest saver of life and property, the airbrake, was forced upon the railroad men much against their will. Why not force them still further to insure the lives of their passengers by the reasonable means noted?

GEORGE S. PAINE

Waterville, Me.

Concerning Cotton Seed

SEVERAL months ago we secured, through one of the commercial photographers, an attractive series of pictures taken in a cotton-seed mill. No member of our regular staff felt himself sufficiently acquainted with this rather special field of industry to prepare an article that would come up to the SCIENTIFIC AMERICAN standard; so we sought an outside source of information. We put the pictures in the hands of a man who had contributed on similar subjects in the past, who had always shown himself competent to handle them, who said he could handle this one, and from whom we had every reason to accept this claim. In due course the article came along, and was printed without further scrutiny, under the above title.

It must be realized that the editor of a sheet like ours is peculiarly in the hands of his contributors. It is physically impossible for our regular staff to hold an expert on every department of modern science and industry; there must arise many occasions when we have to call upon outside writers. When we ask such a person to contribute, it is because he is credited with knowing more about his subject than we do; and we must then ordinarily accept his discussion at its face value. We do not accept offhand anyone's claims or anyone's reputation; but in spite of the utmost care there is bound to be an irreducible minimum of cases in which our best judgment is betrayed.

The gentleman who was supposed to write with authority upon cotton-seed oil turned out to be ludicrously ignorant on that subject. Apparently he consulted some inadequate works of reference, and perhaps one or two ignorant mill-hands, and got up on this foundation a typical high-school composition on cotton-seed oil. This he palmed off on the SCIENTIFIC AMERICAN as a scientific discussion. Some of his errors have been pointed out to us by kind—and unkind—friends.

The fact that cotton-seed oil gums badly does not necessarily imply that it will never be useful as a lubricant; some means will perhaps be found to overcome this objection. This fact, however, does make it at present out of the question for cotton-seed oil to qualify as a lubricant; and in any discussion of the oil of cotton as a substitute for the oil of the castor bean this item should be given first place, instead of being ignored absolutely. It is the present controlling factor.

Doubtless the placing of the world's annual production of cotton-seed at ten million *pounds*, instead of as many *tons*, was a slip; we have verified that it was our contributor's slip, and not ours or our printer's. Perhaps he knows that Egyptian cotton-seed has never commanded a premium *in America;* if he does, his general statement that it sells higher than American seed is an ill-considered one, at best.

Our contributor says that the coating of lint on American seed runs about 20 pounds to the ton. The Government says that no cotton-seed mill may run unless it produces at least 145 pounds of lint to the ton.

Our contributor mentions a law against the stacking of seed near the gin; and he mentions a fan attachment for linters. The promulgator of the law in question, and the inventor of the fan, have succeeded in keeping all knowledge of their work from the millers.

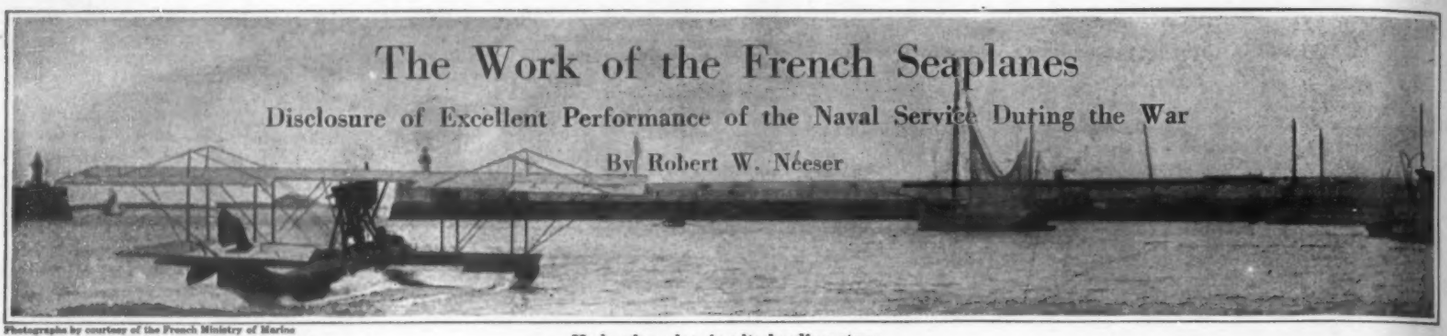
Cotton-seed oil is not colorless; it is described as "mahogany red." American mills, instead of suffering a refining loss of 11 to 15 per cent, feel that they have done badly when this loss exceeds nine per cent. Planters seldom dispose of cotton in the boll; ginning and baling are with equal seldomness done at the mill.

To date, these are all the inaccuracies which have been brought to our attention—except that the photographer transposed the captions of two of his pictures, and that the self-styled expert never noticed the error. Unfortunately, however, while a figure of .400 is highly satisfactory as a batting average, it is a trifle below normal in the preparation of a scientific article. We accordingly arise to express our regrets at the imposition which has been practiced upon our readers, and to assure them that they will not again be imposed upon by this writer.

The Work of the French Seaplanes

Disclosure of Excellent Performance of the Naval Service During the War

By Robert W. Neeser



Photographs by courtesy of the French Ministry of Marine

Hydroplane leaving its landing stage

A BRIEF review of the history of French naval aviation during the war reveals one interesting fact, that, previous to the outbreak of hostilities, the advisability of providing the sea forces with an auxiliary air branch had not been wholly resolved. It was only with the greatest difficulty that, in July, 1914, the Chamber of Deputies was persuaded to vote a small credit for the creation of a naval air service, and when, a few days later, Germany declared war, the general mobilization found the French navy provided with only 13 seaplanes, nine pilots, and 21 cadets.

It was in September, 1914, that the French naval pilots made their first reconnoissance flights under actual war conditions. Two seaplanes were launched from the mother-ship "Foudre" at Antivari for the purpose of exploring the enemy's defences at Cattaro. A second venture was attempted a few days later, but, the circumstances having caused the General Staff to alter its views, the available planes were sent to Port Said, where they formed a welcome reënforcement to the aerial arm of the British Eyptian army operating on the banks of the Suez Canal.

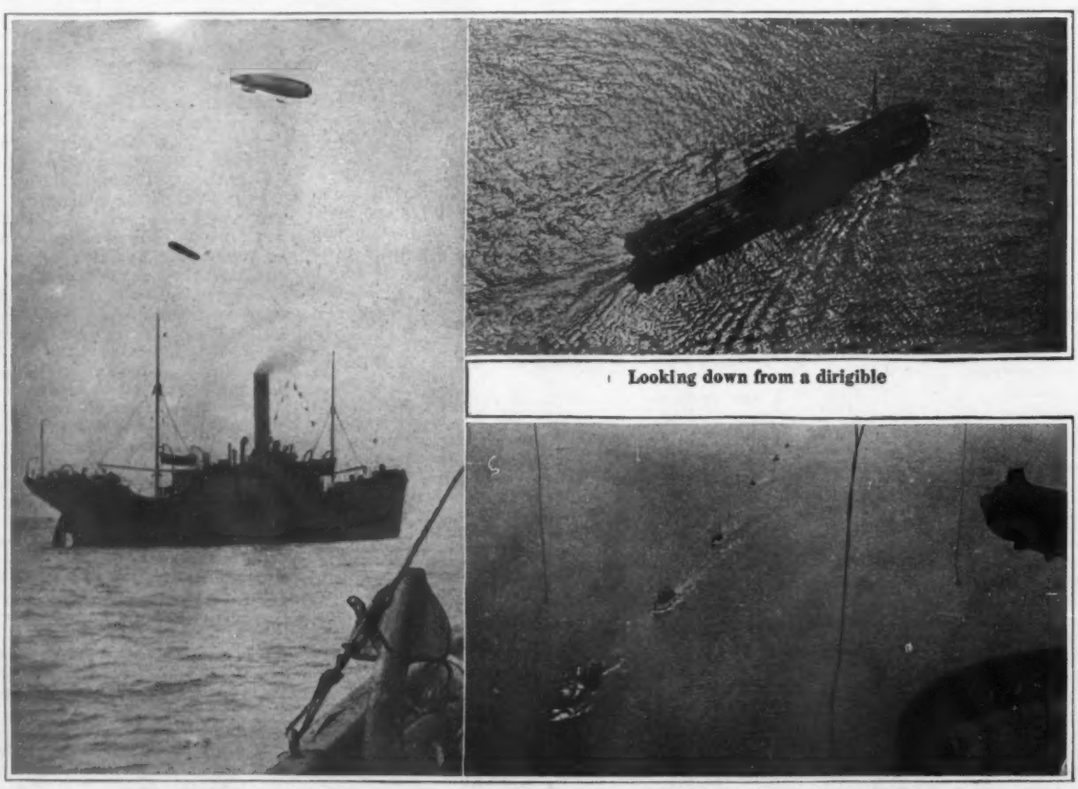
In the meanwhile several escadrilles operating from the Channel ports had proved, by their day and night activities, that the coöperation of this hitherto untried branch of the naval service could second the efforts of the surface patrols to stem the rapidly growing U-boat menace. The first seaplane center was organized at Dunkirk, followed in January, 1915, by one at Boulogne. In the spring of 1915, several escadrilles were located on the shores of the Mediterranean, at Toulon, Bizerte, and Brindisi. The calls of the French army, however, were so pressing that the navy was constantly compelled to subordinate its demands to that of the land forces. But in spite of every difficulty, over 200 seaplanes were distributed to the various centers during 1916, while 300 more were added in the course of the following year.

The protection of the numerous merchant vessels bringing food and supplies to France, the escort of the regular convoys coming from England, Salonica, Egypt, and Morocco, and the maintenance of an efficient patrol over the routes followed by the troop transports arriving from America and Africa, presented a problem which only time and experience could solve satisfactorily. The first seaplanes were compelled, by their extremely small radius of action, to limit their operations to the waters adjacent to the coast line. Little by little, as the models were improved, U-boats were obliged to acknowledge that they had found a worthy foe in the aerial pests that hummed and buzzed overhead. Even the stoic old merchant skippers, who at first were inclined to disdain the company of the "air navy," changed their minds when they saw the U-boats diving for cover on the approach of the patrolling planes, until today the sailormen are few indeed who have not a word of praise for the plucky airmen who have braved the dangers of both wind and wave to make the sea safe for them and their ships.

There have been many accounts written of the work done by the French naval pilots on various occasions, but never has there appeared a comprehensive "resumé" of their achievements. For this reason, the following table which we are able to reproduce through the courtesy of the French Ministry of Marine, is of especial interest:

ACTIVITY OF THE SEAPLANES, October, 1917—August, 1918

Month	Number of Flights made	Hours of flight	Distance covered (miles)	Submarines sighted	Submarines attacked	Mines discovered
1917						
October	1,667	3,094	184,730	7	6	..
November	1,680	3,265	191,000	15	12	..
December	1,730	2,671	147,000	7	7	..
1918						
January	2,236	4,139	214,870	7	6	3
February	2,115	3,690	215,000	8	6	4
March	2,210	4,099	237,410	5	7	8
April	2,647	4,808	284,920	11	8	8
May	3,510	7,652	437,200	22	22	10
June	3,365	6,758	387,940	9	11	9
July	3,959	7,432	432,000	19	14	12
August	4,268	8,594	495,700	20	12	6



Looking down from a dirigible

Dirigible following a ship

A wider view of a convoyed fleet

An Oil Tank That Can Be Towed Anywhere

DURING the war a most successful system of portable floating oil storage was introduced in Great Britain. This system makes use of a vessel which is not unlike the average submarine; indeed, as the subject of the cover illustration for this issue, it might well be taken for a U-boat until studied in detail.

The new British system of portable floating oil storage may well be found useful and economical for many harbors and fuel stations, being capable of removal from position to position, as circumstances may require for bunkering vessels. The system adopted in these craft is automatic-balanced pressure in each oil compartment, the buoyancy space being situated in the upper part of the craft, which forms practically a 'tween decks, and in which is placed the pumping and other gear. The balance of internal and external pressures is maintained by admitting water by open sea connections while pumping out the oil, and *vice versa*, so that the craft is practically kept at a constant draft and trim, and the hull avoids strains which otherwise arise from full and empty compartments.

The experimental craft has been in continuous use during the war, taking in and putting out the same volume of oil, which has been repeatedly used in the testing of tanks in naval work. Careful records have been taken during the whole period, and proof is held that there is no admixture of oil and water, this being prevented by the internal arrangements adopted. This test has been very severe, as the operation of pumping in and out has been very frequent in all compartments of the craft.

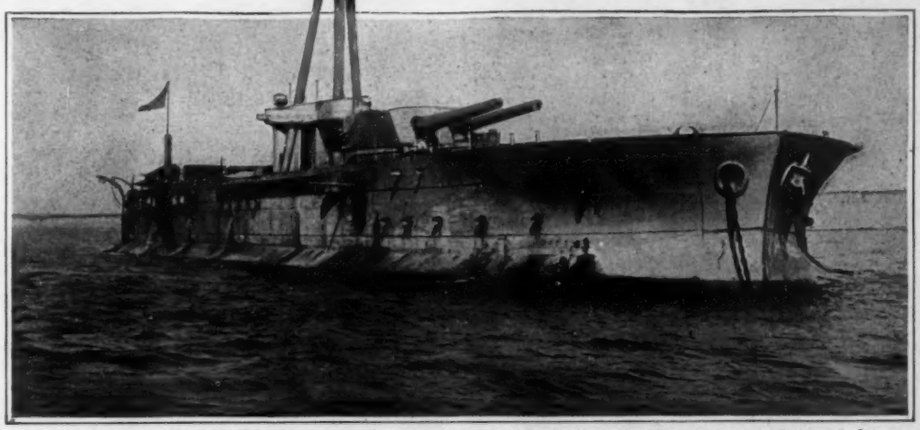
An important fitting embodied in this system is an electrical indicator in the compartment, which is operated from the pump-room, the apparatus radiating in the tank by hand from pump room space, where a register is accurately taken as to the oil level in the compartment, the operating handle being fitted with calibrated scale, so that the actual measurement of the oil is taken at any moment. This fitting has given every satisfaction, and is being fitted in other craft.

The portable floating oil storage systems are worked under British and other patents. This is also applicable, according to *The Shipping World*, to towage craft at sea. In fact, it is intended to be so applied, when circumstances are favorable. Such craft would have embodied an electrical steering arrangement which is operated from the parent towing vessel, enabling craft to be navigated without men on board.

The Monitors of the Present War

A Type of the Fighting Ship That Was Proof Against Torpedo Attack

IN the earlier days of the war some old battleships, such as the "Redoubtable" and the "Venerable," with certain cruisers and gunboats, engaged in operations against the Germans on the Belgian coast; but when the fighting in Flanders had become static and the Germans were busy making fortified submarine bases out of Zeebrugge and Ostend, the British realized that a new type of ship designed specially for the work was needed, if this German coast defense work was to be broken up, or at least hindered. As a result they developed an entirely new type of fighting ship, whose characteristics place it midway between the old monitor of the Civil War and the modern high-freeboard coast-defense battleship. These vessels were given the name of monitor. Like that type, they carried a pair of heavy guns mounted in turrets, but unlike them they had a considerable free-board of from 9 to 16 feet.



The "Abercrombie", one of the larger monitors used in the bombardment of Zeebrugge. She carried two 15-inch guns, with which she bombarded Zeebrugge from a distance of 20 to 25 miles

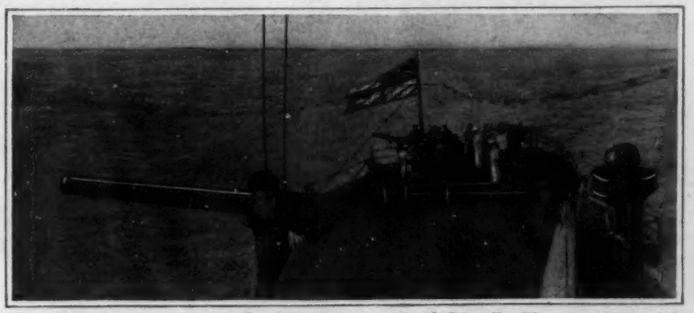
The monitors were built in four classes, known as the Abercrombie, Lord Clive, Marshall Ney and Erebus. The vessels of the first three classes were of from 6,000 to 6,700 tons displacement and 7 knots speed. In length they ran from 320 to 355 feet, but they had the enormous beam, for that length, of 90 feet, this being due to the so-called "blisters," hollow, rounded sections built out along the sides of the ship to a distance of 12 to 15 feet. These blisters were very thoroughly subdivided into compartments, and they were designed to detonate a torpedo at a considerable distance from the ship and allow the energy of the expanding gases to expend itself within the blisters. The device was very successful, the monitors being frequently hit without being sent to the bottom and in some cases with no serious disablement.

The Abercrombie class of four ships were armed with the eight 14-inch guns destined for the "Salamis," which when war began was building in a German yard for the Greek Government. The guns were built by the Bethlehem Steel Company and were taken over by the British Government and distributed between the four monitors. The eight ships of the Lord Clive class were each armed with two 12-inch guns. These were secured from four obsolete battleships of the Mars class. They were short guns, 35 calibres in length, but the mounts were changed to permit of an angle of elevation which gave them a range of 20,000 yards.

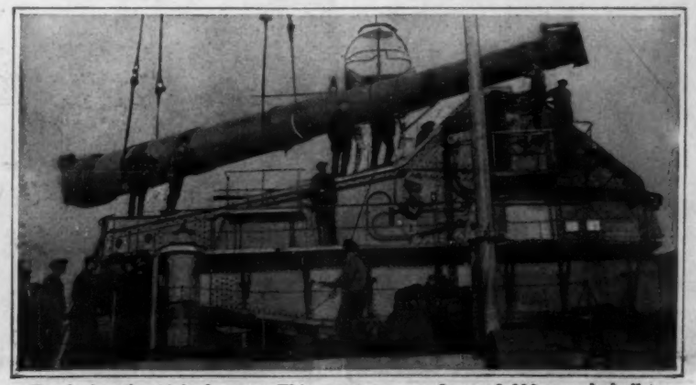
Toward the close of the war two of these ships, the "Lord Clive" and the "General Wolf," had their armament changed and the two 18-inch guns, which had been tried out on the fast cruiser "Furious," were placed on these two ships when the "Furious" was changed into an airplane carrier.

These guns, the largest ever mounted on a warship, are of special interest and we draw attention to two photographs, one showing the gun being lifted into place on its mount and the other showing the gun complete with its housing. Apparently, the turret carried no heavy armor, the housing being merely for the shelter of the gun, but on this point we are not quite certain at the present writing. The single gun was mounted on the after deck of the monitor and it was arranged to fire only on the starboard side and could be traversed only through a few degrees. The maximum elevation was about 55 degrees. The gun looks to be not over 40 calibres in length, and probably the muzzle velocity was moderate compared with current practice in new guns. The projectile is stated to weigh 3,600 pounds. If so, it is heavy, even for an 18-inch gun. The range, with a 45 degrees elevation, is 45,000 yards or 25.5 miles. In our picture, taken aboard the "Lord Clive" looking aft, it will be noted that there are two searchlights on towers on either beam abaft the gun, and on the roof of the housing are two anti-submarine guns and their crews.

Because of the huge blisters on their sides and their small horsepower, these ships were very unhandy. In heavy weather, their speed dropped down to two or three knots, and at all times they were difficult to steer. In addition to the sixteen or eighteen larger monitors above mentioned, several of a smaller type and mounting lighter guns were built. If the information given out by our Navy Department is correct, there were altogether some thirty of these monitors constructed or extemporized.



The 18-inch gun as mounted on the monitor "Lord Clive." The most powerful gun ever mounted on a warship



Emplacing the 18-inch gun. This great weapon fires a 3,600-pound shell to a maximum distance of 25½ miles

The Current Supplement

FIFTY years ago it was supposed that chemistry had been reduced to a fairly exact science, and it is really only within the last decade that it has come to be realized how intricate it is in its orderliness, and many theories have been elaborated to explain its contradictory manifestations, and to reduce them to a clearly comprehensible system. A valuable contribution to this work will be found in *The Classification of the Chemical Elements* in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2253, for March 8th. *Fishing with Spiders' Webs* sounds like fiction, but that it has been, and probably is today, being done by aboriginal inhabitants of far Pacific islands is demonstrated in an article in this issue, which is accompanied by illustrations of the proceeding. *Scenes in Acuma* are a series of unusually interesting photographs of a little known Pueblo community in our Southwestern country, accompanied by some notes telling of the locality and the customs of the inhabitants. *Sugar from Several Points of View* gives much valuable information about an industry of world-wide importance that is intimately connected with our daily food. Economists are looking in many directions for additional sources of power, for constantly the world is becoming more and more dependent on means to reduce and reinforce human labor, and new attention is being directed to the utilisation of our natural sources of power. Of course, water is the most important of these at present, but little is being said just now about utilising the ever-present power of the waves, although that has been a favorite subject with inventors for ages. The article on *"Blue Coal"* reviews and illustrates a number of suggestions for the practical employment of the waves of the sea, some of them being on a very ambitious scale. *The Seasoning of Lumber* is a comprehensive discussion by a scientific forester of a subject of unusual importance, and sets forth the basic facts underlying artificial drying of forest products. Other articles of importance in this issue include *On the Essence of Physical Relativity* and *The After Treatment of Bromide Prints*. The former discusses in a manner interesting alike to physicists and mathematicians some of the collateral issues raised by Einstein's doctrine; the latter presents suggestions which will be of value both to professionals and amateurs.

Army Telegraph Work in France

ACCORDING to a recently published account, the Army has handled the extensive telegraph work incumbent on it in an efficient manner. On November 15th, 1917, American telegraphic communication was opened between Bordeaux and Paris, with a few telegrams. By November 15th, 1918, the small office had expanded into an establishment requiring a personnel of 50 men and a plant with 32 desk telegraph outfits from which radiate circuits to 25 outside cities and camps. On one day, October 8th, this central office handled as many as 4,620 telegrams. One of the quickest wire-laying jobs on record goes to the credit of men stationed at a rest camp near by. At the time when the telephone exchange was moved from its former location to the new headquarters it was necessary to install 100 circuits between the new building and the French Exchange, a distance of nearly a mile, through the busiest part of the business district. The presence of signal and power wires in the air at various points made the installation of an overhead cable impracticable. A full Infantry Company of 220 men was selected for duty. They went to work at 7 P. M. with picks and shovels, and with the aid of 12 acetylene searchlights they worked all night. At 7 A. M. they were relieved by another Infantry Company increased by the original personnel of the Signal Corps of 50 men, and 20 colored stevedores. The work continued in this way from 7 P. M. Friday night until 2 A. M. Monday, when the whole cable was completed.

Transforming British soldiers into civilians. At the left they are handing in their rifles and other equipment; at the right they are being measured for the civilian clothes which the government will forward to their homes

Reconstruction in Europe—IV

From Fighting Line to Factory

By C. H. Claudy, Foreign Correspondent of the SCIENTIFIC AMERICAN in London

IN "A Job for Every Man" in the SCIENTIFIC AMERICAN for December 21st, an attempt was made to show how the United States was handling its demobilization problem, from the standpoint of the individual soldier. In the States the problem is largely one of the individual, for we have taken but four millions, roughly, from a total population of over a hundred millions, and our commercial expansion is such that there are more jobs, certainly, than there are skilled men to fill them, and probably enough jobs for all the unskilled if a reasonable interval is allowed for the absorptive power of industry to work upon the demobilized men.

In Great Britain, however, the problem presents complications which America happily does not have, and it is, therefore, to the greater credit of the nation that such very comprehensive plans should have been worked out well in advance of the need.

It may be wise to consider for a moment the real problem of all demobilization, as opposed to the view of it entertained by the thoughtless, and particularly the relative of the man to be demobilized. It is no more than natural that mothers cannot understand why their sons cannot be immediately released, when the need for their services has passed, and demobilization means to many who have not reflected, merely the process of transporting a soldier from fighting field or training camp to his home town and turning him loose. But to those who must guard the welfare of the body politic as a whole, regardless of the wishes of loving relatives, demobilization means the intricate process of turning a war machine into a peace machine, of relocation of men in constructive and productive labor, of salving as much as may be of war equipment, of turning factories and industry generally from the production of munitions to the production of those things which peace needs, all without interfering with the fundamentals of human life—food, clothing, shelter—to such an extent as to cause first physical and then mental distress.

Upon the success with which this task is performed depends, in a very large measure, the solution of the question as to whether the world is to be a safe place for a true democracy or a breeding ground for Bolshevism.

The limiting factors in any scheme of demobilization which is to be comprehensive and effective and not end in catastrophe and riot are: first, transportation, second, distribution of labor, third, absorptive power of industry, and fourth, the supply of raw materials. They are placed in this order because before a man can be demobilized he must be moved; before a number of him can get jobs, some scheme must be worked out by which no industry is over supplied or starved of labor; before any great number of men can be flung into industry, the ability of industry to turn from making, let us say, shells to baby carriages or from artillery wheels to automobile wheels, must be considered; and finally, before any industry can resume its peace basis character it must be assured of an adequate if not an ample supply of the raw materials by means of which it exists.

Demobilized men receiving their unemployment donation policies at the Wimbledon Dispersal Camp

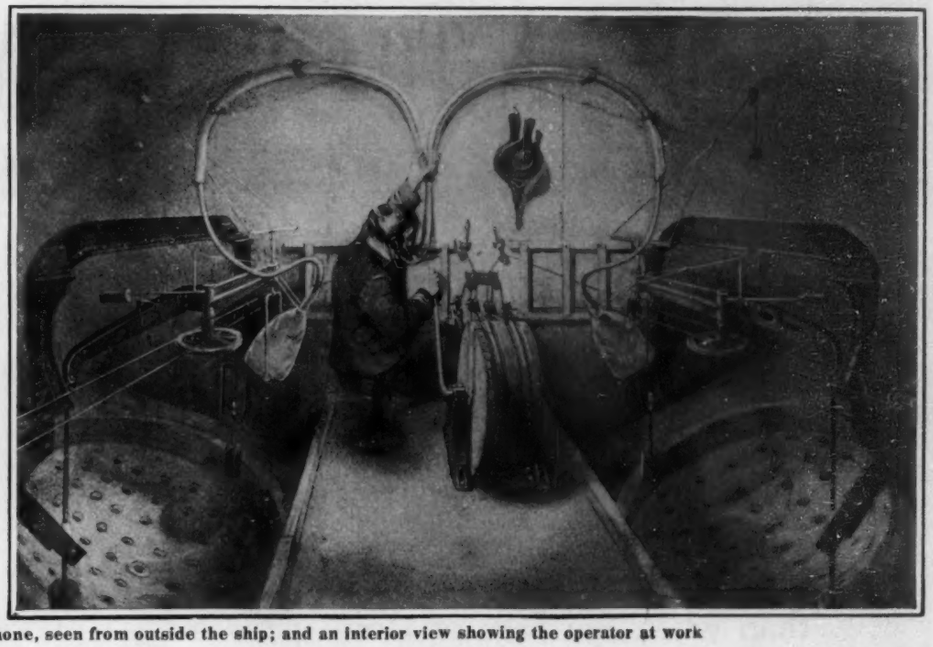
These things are abstractions, applying no more to England than to America. But the English method of fitting her demobilization scheme to the fundamentals is very complete and very well worth study.

Its most salient characteristic is that men are to be demobilized not by military units, but by the requirements of industry. In other words, demobilization will be by individuals, not by companies, regiments or other military divisions. This is more difficult, from the military point of view, but infinitely preferable from the economic point of view.

If this fact is not plain, it may be mentioned that it would be obviously unfair to the troops abroad to demobilize all the troops at home first, thus giving them the "pick of the jobs," merely because they happened to be on the spot. Again, demobilizing by individuals and not by military units means an infinite duplication of orders, routing, collection, sorting, feeding and housing—to do these things for a regiment is one thing—to do them for

(Continued on page 236)

Demobilized men being fed by the W. A. A. C. as they pass through the demobilization camp at Wimbledon



The "acoustic lens" of the hydrophone, seen from outside the ship; and an interior view showing the operator at work

The Hydrophone for Locating Submarines

An Ingenious French Invention That Did Much to Make the Seas Safe for the Allies

MUCH reliance was placed, during one period of the war, upon the use of airplanes in the detection of submarines. The fact is, however, that when the U-boat submerges to a depth of 15 yards its whitish trail is invisible from above, and we must fall back upon some other means of locating it; and this means we must seek some way of employing, in the work of detection, the sound waves propagated by the screws and auxiliary machinery of the submarine. But it must be remembered that while these waves travel through water with a speed four times that which they exhibit in air, there is no possibility of perceiving them directly by ear. It is necessary to have recourse to an instrument which can pick the waves out of the water and transmit them to a listener lodged in a habitable medium.

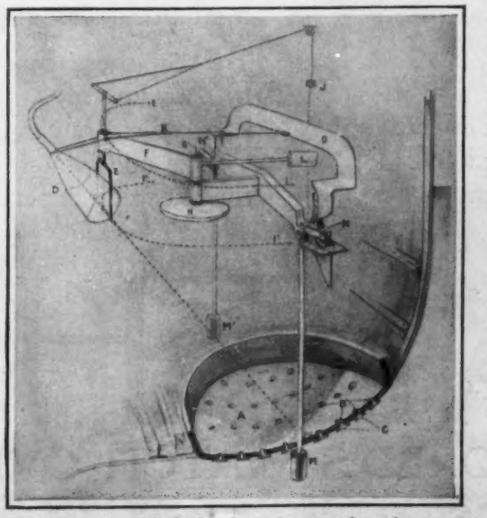
Several such devices existed before the war. In addition, a quantity of inventions of one sort or another have seen the light of day since. The range of all these listeners varies greatly, being affected by factors as yet imperfectly understood, although it is definitely known that it increases with the depth to which the listener is submerged and with the velocity of the screw whose sound-waves are received. On the average, the hydrophones of common type will detect the presence of a submarine at a distance of two or three thousand meters, and of a large surface squadron at ten or a dozen kilometers. But all these instruments suffer from the very grave disadvantage that they will work only when the ship on which they are mounted is stopped, so that its machinery does not drown out that whose noise it is desired to hear. In addition, most of them lack the ability to distinguish from one another sounds proceeding simultaneously from different directions; and when there is but one sound they indicate only in the crudest fashion the direction from which it is received.

There was accordingly the very obvious and very crying need for a hydrophone that would work while its ship was running, and that would be sufficiently precise to enable that ship to steer a straight course for the submarine whose presence was revealed. In the end it was a French naval lieutenant, Georges Walser, who achieved the success which had eluded the world's savants for three years. His solution of the problem is a highly ingenious one, depending upon a very simple principle of physics, yet one which it had occurred to no one to utilize. It is now possible to reveal his invention for the first time; the French government has permitted *l'Illustration* to illustrate and describe the Walser hydrophone, and we present the pictures and data through the courtesy of our contemporary.

The fundamental fact upon which Lieutenant Walser built is that sound, like light, is refracted on passing from one medium into another. We are accustomed to diagrams which assume that the complex of light from a given object consists of a number of component waves, which may be taken to be parallel if their source is sufficiently remote, which remain parallel so long as no obstruction is interposed in their path, and which are bent as soon as they are called upon to enter a medium of different density from that in which they were propagated. And it is just so with sound waves.

Walser therefore interposed, in the path of sound waves, a sort of acoustic lens. Just as in the case of light, this causes the individual waves which make up the sound complex from a given source to come to a focus, with the double effect of strengthening them and isolating them from the sounds that proceed from other sources. In fact, the several sources of sound give rise to as many foci, of which the geometric locus can be determined by calculation; and in the same way, from the position of the sound focus which pertains to any particular source of sound, the position—or at least the direction—of that source can be calculated.

Once this general idea had been formulated, it remained for the lieutenant to work out the practical details. As finally adopted and used with huge success in the detection of submarines, the acoustic lens was in the form of a spherical segment A, set into the side of the chaser or destroyer. In the bulging surface of this are a series of circular holes B, each filled with a sensitive vibrating plate C. The effect is to focus all sounds received; and the focal points all lie on a circle I, whose position, of course, depends upon the radius of the lens segment and other factors which can be controlled. There are two of these lenses on each vessel, one to port and one to starboard. The two give upon a single cabin, which of course extends the entire width of the ship, and is well insulated against sounds at all points save the two lenses. The observer is seated in the center of the cabin, with a listening helmet to which are attached two ear-trumpets, of which only one is shown at D in our diagram. One trumpet, of course, pertains to the port lens and one to the starboard.



Working parts of the hydrophone (see text for references)

The trumpet D is carried on a fork E, which is moved from the wheel H through the arm F and pivot G. The wheel H is connected with the rotating drum that appears in the general view; and the mechanism is so adjusted that as the operator turns the handle of this drum, the two trumpets revolve about the respective focal circles of the sounds received.

The counterweight J and cord K hold the trumpet in a position where its axis is constantly directed toward the center of the spherical lens. The counterweight L maintains the equilibrium of the mobile arm F. The counterweights M, M′, cause this arm to oscillate about the pivots N, N′, in such manner as to counterbalance the effect of the ship's pitching and keep the mouth of the trumpet always in the same horizontal plane. The entire apparatus is supported by the frame O.

In using the apparatus, the observer can hear a given sound, not only when the trumpet is precisely centered at the focal point of that sound, but when it is anywhere in the neighborhood of that point. He hears it loudest and clearest, however, when the axis of the trumpet passes through the focus, so that the trumpet is centered about the focus. He explores the field by keeping the trumpet continually in motion; and he locates every suspicious sound by carefully bringing the trumpet to the position where it is loudest and clearest. The instrument has been previously calibrated, so that when he succeeds in getting the maximum intensity for a given sound, he reads the direction of its origin on the scale that runs about the edge of the drum. The distance is then estimated roughly by taking account of the intensity of the sound at its maximum; and it is then easy to steer a straight course for the source—and, if the latter be a submarine, to pass directly over it with mathematical accuracy and drop sudden death upon it.

The first successful experiments with a more or less definite model were made on March 31st, 1917. After that, progress was slow, both in the way of removing the last technical obstacles, and in the more difficult business of convincing the "appropriate authorities" that here was something good. All these difficulties were surmounted, however; the apparatus was installed, and on March 16th, 1918, it received its baptism of fire. Its success was immediate; and from that date to the end of the war it made a very large contribution to the nullification of the submarine menace.

A CAMPAIGN TO PROTECT YOU IN BUYING

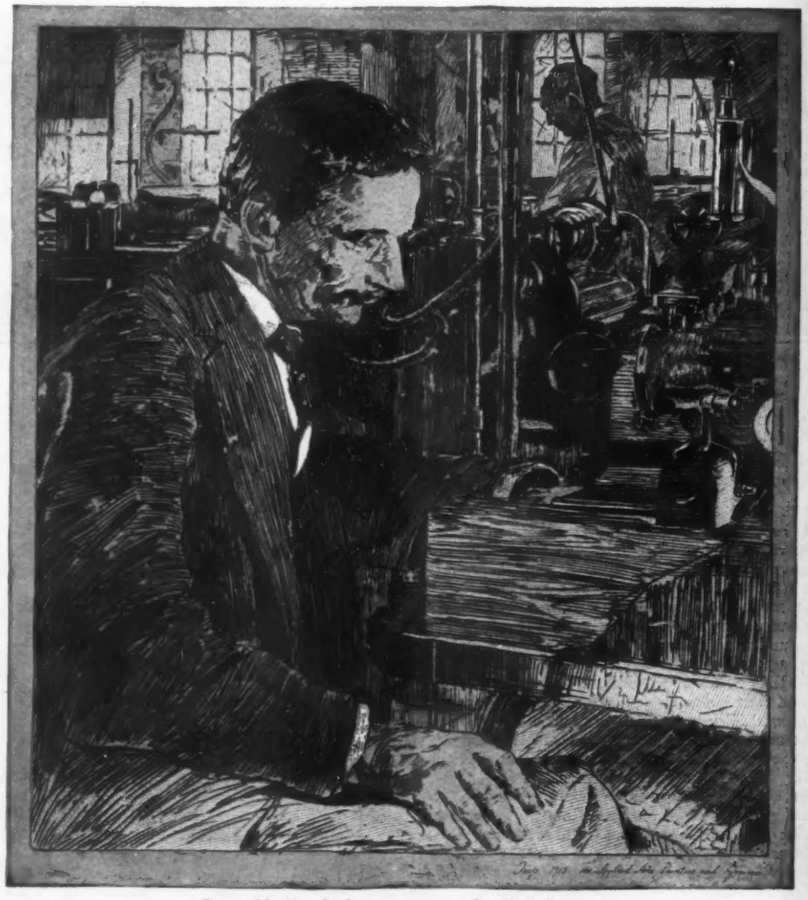
RALPH WALDO EMERSON, speaking in one of his essays of a distinguished man, said: "He is put together like a Waltham Watch."

No finer tribute was ever paid this American masterpiece than when the Sage of Concord used it as the symbolic character of greatness.

The Waltham Watch represents the genius of many men whose inventive faculties have been concentrated for nearly three-quarters of a century to make it the wonderful time-keeping device it is.

Among these famous watch makers and inventors is enshrined the name of Duane H. Church—a man whose marvelous grasp of the principles of mechanics filled the great shops at Waltham, Massachusetts, with exclusive machinery that performs miracles of accurate and delicate work which the human hand could not equal.

Many of these machines are awe inspiring to the beholder. One of them will do the work of a hundred skilled workmen—do it better and with greater accuracy. They demonstrate American mechanical skill at perfection.



Duane H. Church, famous inventor who filled the great shops at Waltham, Massachusetts, with exclusive watch-making machinery that performs miracles of accurate and delicate work which the human hand could never equal.

To see these machines is to know beyond the shadow of a doubt why Waltham is the "World's Watch Over Time," and why the foreign-built watch cannot compare with it in time-keeping dependability.

WALTHAM

THE WORLD'S WATCH OVER TIME

TO INSTRUCT YOU IN CHOOSING YOUR WATCH

The buying of a watch is an important matter. It is an investment in time-keeping. And time is the most valuable possession of man.

Very few people know anything about watches.

The "works," or mechanism, of a watch is a mystery. Yet we can truthfully say, "A watch is only as good as its works."

You buy a watch for one thing—to keep correct time for you—to tell it to you with dependability any moment of the day or night.

A good watch must have something more than good looks—it must have good "works."

Millions of people imagine that the "best" watch is made abroad—or, at any rate, that its works are imported from there.

Yet, in competitive horological tests at the world's great Expositions, Waltham has not only defeated these watches of foreign origin, but all other watches as well.

In a series of advertisements we are going to show Americans that there is a watch built in the United States whose time-keeping mechanism is superior to that of the foreign-built watch,—

A watch that is easily and reasonably repaired because its parts are standardized,—

A watch that represents American leadership in mechanical skill,—

A watch that has revolutionized the art of watch making and assured accurate and dependable time-keeping.

In this important series of advertisements we are going to take you through the "works" of a Waltham watch; lay bare those hidden superiorities which have led the horological experts of the greatest nations of five continents to choose Waltham as *the* watch for the use of their government railroads.

We are going to strip away theory and show you facts—every part from the frame to the dial, hands and case.

When you finish reading these advertisements, which will appear regularly in the leading periodicals and magazines, you will walk up to your jeweler's counter and demand the watch you want—because you will know how it is built and why it is superior to the foreign watch.

Look for these advertisements. Read them.

WALTHAM

THE WORLD'S WATCH OVER TIME

Mechanical Equipment of the Farm

Latest developments in agricultural machinery and practical suggestions for the farmer

Conducted by HARRY C. RAMSOWER, Professor of Agricultural Engineering, Ohio State University

A Lantern that Burns Gasoline

A MOST useful and withal economical lantern is shown in the accompanying photograph. This lantern burns gasoline under pressure. The bowl is filled about three-fourths full of gasoline and then by means of a common hand bicycle pump air is forced into the bowl until a pressure of some ten to thirty pounds is produced. The fuel is burned in a mantle burner. Passing from the bowl to the burner, the gasoline is taken through a hot tube and vaporized. This tube is first heated by an alcohol torch; after the burner becomes hot a specially contrived stove keeps the generating tube sufficiently hot to gassify the fuel.

The mantle is of the inverted type. With a pressure of 16 pounds this lantern will develop 147 candle-power and will burn for 23 hours on one gallon of fuel. The efficiency of the light varies greatly with the pressure. It is, therefore, necessary to keep the pressure as high as possible. Air should be charged into the bowl every few hours, or at least every time the lantern is used. The flame can be turned down quite low in this particular lamp. It is also provided with a cleaning lever, which makes it possible to clean the pin hole in the end of the generating tube while the lamp is burning. This hole is likely to become clogged with soot from the burning fuel. A good cleaning arrangement, however, renders this difficulty of little consequence.

Of course the lantern cannot be roughly handled for fear of breaking the mantle. It can, though, be safely carried about and being provided with a mica globe wind does not affect it. It is especially desirable for use in dairy barns and is widely used by dairymen. When hung in the center of a barn it sheds a splendid light into all corners. It is not necessary to move it about, as is the case with the common kerosene, wick lantern.

Incandescent mantle lantern that is very convenient for farm use

Official List of Farm Tractors

IN connection with the annual Farmers' Week activities at the Ohio State University, the Department of Agricultural Engineering conducted a series of tests on 23 farm tractors which were exhibited during the week. Each tractor underwent a two-hour test on the prony brake, which is a piece of equipment designed to measure the belt power of a motor. Each tractor was belted to the brake just as it would be to a thresher. Thirty minutes were then allowed each operator for the purpose of making necessary adjustments to put the motor in good running order. The load was gradually increased while the motor was warming up.

At the close of this 30-minute period the motor was adjusted to run at a speed as close to its rated r. p. m. as could be secured and at the same time the brake was adjusted so as to give the tractor its rated load. A one-hour fuel economy test was then run.

The motor fuel line was disconnected and connections made to a tank resting on a delicate scale. All tractors used fuel from the same source. At intervals of 10 minutes, fuel weighings were made, while at the same intervals the speed of the motor was taken. This made it possible through the several intervals to check the constancy of fuel consumption as well as the efficiency of the motor governor.

At the close of the one-hour test the motor was given all the load that it could pull with the operator given permission to increase the speed if he so desired and was able to do so. The maximum load was pulled for 30 minutes.

The accompanying table shows in detail the results of the tests. Many interesting observations can be made by studying the figures here shown.

Of the twenty-three tractors tested five had two-cylinder motors. The two machines giving the lowest fuel cost per horse-power hour were both two-cylinder types and both burned kerosene. The average fuel cost of these five motors was 1.582 cents per horse-power-hour. The average of all four-cylinder motors burning kerosene was 2.035 cents per horse-power-hour, or, a difference of 0.45 cent. This would mean a difference in cost in favor of the two-cylinder type of 9 cents per hour with the motor developing 20 horse-power. However, some of the four-cylinder motors made very poor tests and if the five best tests on this type of motor are compared with the five two-cylinder motors the difference is only 0.09 cent, or, an amount equal to only 1.8 cents per hour for a motor pulling 20 horse-power. It should be remembered, though, that the burning of kerosene gives rise to some difficulties in motor operation and that fuel economy is not the only consideration.

Another matter affording an interesting comparison is that showing the reserve power, or lack of it, in the several machines. An indication of this reserve may be found by comparing the h.p. developed during the fuel test, which approximated the rated horse-power, and that developed on the maximum test. The fifth machine tested showed what could honestly be called real reserve power. A little more than the rated load was pulled at less than the rated speed. A 23.5 per cent overload was pulled without increasing the speed. In other motors it was necessary to increase the speed very decidedly, to make a showing on the maximum test. Certainly excessive speed is not a thing to be desired. It would be in the interest of durability and long life if motor speeds were generally lower.

Seven of the tractors for one reason or another failed to pull their rated loads. With some the adjustments were decidedly off—in one case

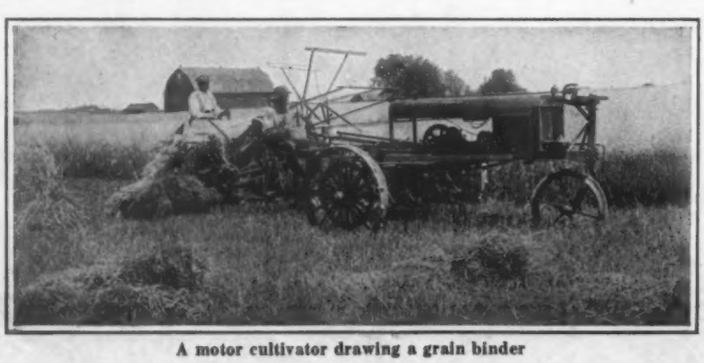
(*Continued on page 238*)

The Official Results of Farmers Week Tractor Tests

Conducted by the Department of Agricultural Engineering, Ohio State University, January 27 to 31, 1919

Tractor	Rating	Motor	Bore Ins.	Stroke Ins.	Rated R. P. M.	Av. R. P. M. During Fuel Test	H. P. Developed Fuel Test	Fuel	Lbs. Fuel Used per H. P. Hr.	Cost H. P. Hr. Cts.	Max. H. P. Developed	Motor R. P. M. Max. Test	% Overload + Underload −	Oil Temp.	Water Temp.	REMARKS
1	8–16	Withdrew														
2	9–18	4 Cyl. V. H.	3½	5	1,650	1,670	20.80	Gas	.919	3.73	28.75	1,772	59.7+	155	210	Motor speed increased for maximum test.
3	11–22	4 Cyl.	4	5	1,000	1,122	21.40	Kero	.885	1.77	21.40	1,122	2.72—	120	212	Motor speed increased under constant load.
4	12–20	4 Cyl.	3¾	5½	1,400	1,340	19.20	Gas	.966	3.92	19.20	1,340	4.00—	120	185.5	Trouble lining up to brake and holding tractor in line.
5	12–20	4 Cyl.	4¾	5	900	882	20.50	Kero	1.097	2,194	24.70	883	23.5+	120	212	Motor had reserve power at same speed.
6	15–27	4 Cyl.	4½	6	900	862.5	27.60	Kero	.833	1.666	27.60	862.5	2.2+	120	212	Added water to radiator.
7	10–18	4 Cyl.	3⅞	5	1,050	1,125	19.80	Kero	.867	1.734	19.80	1,125	10.0+	100	190	Motor speed 75 above normal.
8	12–25	4 Cyl.	4	6	950	940.5	19.20	Kero	.799	1.598	19.20	940.5	23.2—	140	212	Motor speed gradually decreased during test. Rated load not pulled.
9	15–25	4 Cyl.	4¼	5¾	850	859.2	25.30	Gas	.7055	2.864	31.8	913.8	27.2+	158	184	Hydraulic governor. Speed regulator close.
10	12–25	2 Cyl.	6½	7	450	488	18.3	Kero	.892	1.784	18.3	488	26.8—	...	212	Not able to pull rated load.
11	10–20	2 Cyl.	6½	8	500	519.85	20.6	Kero	.7524	1.504	24.1	509	20.5+	124	210	Speed varied only 4½ rev. during fuel test.
12	12–20	4 Cyl.	4	6	900	929	20.5	Kero	.916	1.832	21.4	930	7.0+	110	200	Showed small reserve at same speed.
13	12–20	2 Cyl.	6	8	560	557.3	20.0	Kero	.7715	1.543	25.5	582.1	27.5+	180	.....	Showed reserve at slight increase of speed.
14	30	2 Cyl.	6½	7	750	882	30.8	Kero	.7522	1.504	37.5	783	25.0+	...	.....	Speed fluctuated. Water adjustment changed on max. test.
15	20–40	4 Cyl.	5½	7	825	840	33.6	Kero	1.270	2.540	33.6	840	16.0—	...	177	Motor not able to pull rated load.
16	12–25	2 Cyl.	6½	7	750	733	21.2	Kero	.791	1.581	21.2	733	15.2—	120	166	Motor not able to pull rated load.
17	15–30	4 Cyl.	5	6½	900	910.8	30.3	Kero	1.106	2.212	33.4	909	11.33+	130	170.4	Motor speed varied only 7½ rev. during test.
18	12–25	4 Cyl.	4	6	900	998	24.5	Kero	.8167	1.633	25.03	940	0.12+	120	173	Motor speed increased gradually during test.
19	12–25	4 Cyl.	4	6	900	889	14.4	Kero	1.719	3.438	14.4	889	42.4—	104	203	Rear bearing of motor ran hot. Cam shaft badly timed.
20	12–25	4 Cyl.	4½	5¾	1,000	1,087	26.9	Kero	.976	1.952	28.3	1,036	13.2+	160	179	
21	9–18	4 Cyl.	3¾	5¼	1,100	1,130	18.55	Gas	1.216	4.937	18.55	1,130	3.05+	138	158	Tractor rear wheels raised 8 in. to allow belt over front axle.
22	15–30	4 Cyl.	5¼	8	575	598	31.1	Kero	1.080	2.160	35.0	585	16.6+	...	.....	Motor performed poorly during test.
23	12–24	4 Cyl.	4	6	1,000	985.5	24.85	Kero	.869	1.738	24.85	985.5	3.5+	...	.....	Motor speed decreased during test.

Kerosene, 13.5c gal. or 2.0c a lb. Gasoline, 25.5c gal. or 4.06c a lb.



A motor cultivator drawing a grain binder

Another Use for the Motor Cultivator

THE motor cultivator is, quite naturally, used on farms growing a large acreage of corn, but, even so, the larger the number of days it can be kept busy the more economical will the investment prove. With this end in view, farmers are finding numerous tasks that this machine can assist in performing. The photograph on this page shows a grain binder being drawn by a motor cultivator. There is no reason why it should not perform this work in a satisfactory way. It can also be used for drawing corn planters, mowers, drills, and other tools of similar draft. It should prove a splendid complement to the heavy tractor on the large farm.

Being Right a thousand times

IN a great quiet room of the Billings & Spencer plant, row upon row of master craftsmen give the best there is in them to a work as delicate as fine watchmaking.

They are cutting, with lifetime trained fingers, the shapes of the forgings in great blocks of solid steel.

They are making the master dies, and no matter how long the task may take, the only requirement is absolute accuracy —absolute compliance with specifications.

For when that die is gripped in the ram of a great drop hammer—when it falls with crashing weight upon the bars of white-hot steel—forgings take shape which duplicate that die to the hair's breadth of an inch. The die cutter is right, not once, but a thousand times.

So it is with the men to whom fourteen-foot hammers are pliant servants—and the men who for a lifetime have studied steel—and the men who do nothing all day long but temper dies—their only goal is that the Triangle B forging shall be right, not once, but always.

This company is the first commercial drop forging plant in America.

When Abraham Lincoln entrusted to C. E. Billings the forging of the pistols of the Black Horse Cavalry, he made possible the beginning of that long and honorable record which has culminated in the great Billings & Spencer plant of today. "Into every forging goes our entire reputation." That is the Billings & Spencer creed.

B

"RELY ON ME"

The BILLINGS & SPENCER CO

Hartford

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The First Commercial Drop Forging Plant in America

Drop Forgings Hand Tools Forging Machinery

Inventions New and Interesting

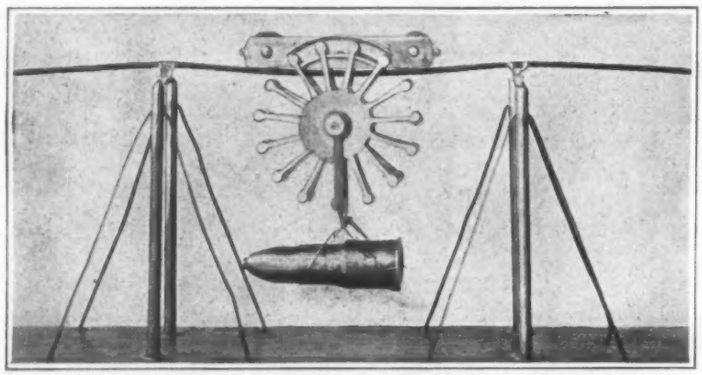
A Department Devoted to Pioneer Work in the Arts

An Overhead Cable Track Supported from Both Sides

SOMETIMES a discovery or invention can be spoken of as having "solved the problem" of this or that. Sometimes on the other hand, the inventor succeeds in doing something which, prior to his disclosure, would have been conceded by everyone to be impossible—something which appeared so obviously out of the question that nobody would ever have thought of trying it—something in connection with which, therefore, the existence of a "problem" to be "solved" would never have been recognized.

There have been two ways of running in constant contact with an overhead wire which is sufficiently long to require support at other points than its ends. One is seen in the ordinary trolley wheel, where the wire is sufficiently underslung from its supports to permit a more or less deeply grooved wheel to run, in turn, under it. The other may be found in various places where a carrier of one sort or another is run, suspended from a cable; it consists in supporting the cable from one side only, on the end of a bracket, and in hanging the car from the cable by means of an outcurving truss which passes around and over the wire on its free side, to engage a trolley wheel above the wire. Of course, if there is any material weight to be carried, this procedure involves two wires, supported from their opposite and outer sides, so that the carrier may itself be supported from each side.

A New York inventor has recently put out a device which makes it possible to run a carriage, suspended from wheels, along a cable that is supported from both sides. The fashion in which this apparent impossibility has been brought about, and the car enabled to pass the supports of the cable, is indicated in our cut. It will be noted that the member connecting the two traction wheels is traversed on either side by a grooved track in the shape of a circular arc, and that the carriage is suspended by means of a toothed circular wheel of corresponding radius. The "teeth" of this wheel are the things that reveal the secret of how to do the impossible. Open at the ends, each tooth engages the circular track on both sides of the wheel-truck. Until a support is encountered, the suspension "wheel" has no motion of its own; but as soon as it encounters the barrier offered by one of the supporters, it is forced to rotate. Then, like a monkey on a stick, it climbs around the supporter and emerges safely on the other side, never losing its grip on the grooved track. In fact, at all stages of operation at least three of the teeth are engaged with this track.



The carrier that passes the supports of a cable way when these appear to block all passage

Perhaps it would be even more to the point to compare the operation of this elegant little device to a gymnast, performing on the flying ladder, and passing a series of bars suspended a foot or so beneath his ladder. If this were proposed as a problem, we should at once picture how the performer was going to slip under each obstruction, with one hand gripping the last rung of the ladder and another reaching for the next. The inventor has given us a most elegant mechanical version of this action.

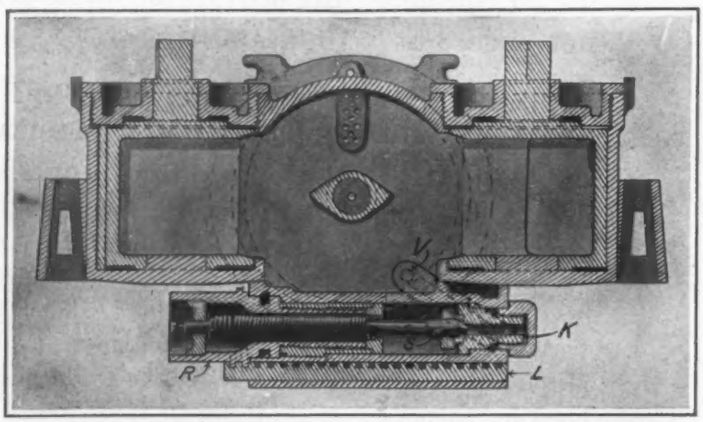


Diagram of the controlling screw and rack of the high-pressure reduction nozzle

The use of this device, it is predicted, will effect considerable saving, inasmuch as cable ways which must now be sufficiently substantial in construction to be supported from one side can be built much more lightly for symmetric support. The invention should be of particular value in mining, logging and construction work. It is pointed out that in the laying of pipes and mains, the device can straddle the trench and make it easy to lay the pipe in its correct final position with a single handling. In general, it should greatly simplify cableway transfer in both accessible and out-of-the-way places.

High-Pressure Hydrant Regulation

By C. W. Geiger

ON the morning of April 18th, 1906, a severe earthquake was experienced along the California coast. The shock broke the water mains leading into San Francisco from San Mateo County, leaving no ready means of defense against the several small fires started by wires that had become crossed during the brief period of vibration. For three day the conflagration raged, destroying property valued at over $300,000,000. To guard against a repetition of this experience, an auxiliary water-supply system for fire protection was installed.

The area thus protected exceeds eight square miles. Due to the city's irregular topography it was necessary, in order to secure fairly uniform pressure in both high and low lying districts, to divide the proposed area into two zones, each supplied from a separate and independent reservoir. Both zones, however, can be connected to the main supply reservoir.

These two reservoirs supply water at an average pressure of 150 pounds to the hydrants in their respective zones. By cutting the lower zone into the reservoir normally supplying the higher portion of the city, an average pressure of 210 pounds can be obtained at the hydrants in the former. This showing can be equalled in the higher districts by connecting the supply mains there directly with the main storage reservoir, which has an altitude of 760 feet. Finally, an average pressure of 300 pounds and a maximum of 329 pounds can be got in the lower zone by similarly utilizing the direct head of the main reservoir.

Installed primarily to control another quake emergency, should such ever arise, this installation obviously cannot eco-

(Continued on page 238)

The newly designed reduction nozzle for San Francisco's high-pressure hydrants. At left and right, external and sectional views of the nozzle; center, attaching the nozzle to the hydrant

"Your Nose Knows"

All smoking tobaccos use some flavoring. The Encyclopaedia Britannica says about the manufacture of smoking tobacco, "...on the Continent and in America certain 'sauces' are employed... the use of the 'sauces' is to improve the flavour and burning qualities of the leaves." Tuxedo uses *chocolate*—the purest, most wholesome and delicious of all flavorings! Everybody likes chocolate—we all know that chocolate added to anything as a flavoring always makes that thing still more enjoyable.

That is why a dash of *chocolate*, added to the most carefully selected and properly aged burley tobacco, makes Tuxedo more enjoyable—*"Your Nose Knows."*

Try This Test: Rub a little Tuxedo briskly in the palm of your hand to bring out its full aroma. Then smell it deep—its delicious, *pure fragrance* will convince you. Try this test with any other tobacco and we will let Tuxedo stand or fall on your judgment—

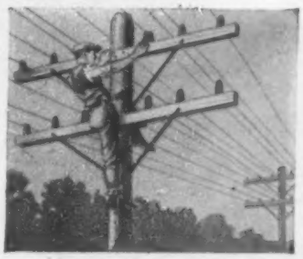
"Your Nose Knows."

Tuxedo

The Perfect Tobacco for Pipe and Cigarette

Guaranteed by

The American Tobacco Co
INCORPORATED



Take a Tip from the Lineman

High above the ground, in rain, snow or sleet, the lineman takes his chances for your comfort.

His tools must be the best—there can be no doubt, no question, where life is risked.

Red Devil
REG. U.S. PAT. OFF.
Pliers

are his choice. He knows that they are designed right, forged right, finished right; he knows they will not fail him in the emergency.

Take a tip from the lineman. The tools he uses are right tools for you. He chose "Red Devils" as an expert, knowing exactly what depended upon them. Take advantage of his expert judgment.

Ask your hardware dealer to show you the models best suited to *your* needs.

SMITH & HEMENWAY COMPANY, INC.

Sales and Export Office:
266 Broadway, New York, N. Y.
Factories: Irvington, N. J.

"Red Devil" is the Expert Mechanic's guide to known quality in Pliers, Electricians' Tools, Hack Saw Frames and Blades, Auger Bits, Chain Drills, and other Hand Tools, all of a class with "Red Devil" Glass Cutters, the biggest sellers in the world.

American Substitutes for Boxwood

(Continued from page 223)

ciently large trees of witch hazel, great rhododendron, and mountain laurel can undoubtedly be found in the southern Appalachians.

Among coniferous woods there is none uniformly hard enough to compare with boxwood. Mention should be made of some very fine textured species which are almost homogeneous in appearance and are hard enough to take a good polish.

Yellow cedar, which grows along the coast from Alaska to southern Washington and in the Cascade mountains southward into Oregon, is one of the finest textured conifers. Its wood has a clear yellowish color and a distinct spicy odor, and is well fitted for novelties.

Pinon, one of the nut pines of the Southwest, is the hardest and heaviest of the soft pines, and has a very uniform structure. The heartwood is yellowish or creamy brown in appearance. Although this species would not do for engraving purposes, it apparently would be excellent for cheaper grades of chessmen, for it works easily and takes a smooth polish.

Other very fine textured coniferous woods are the Arizona cypresses, the junipers or red cedars and the western yew. The wood of the latter two species, however, is dark, reddish brown in color and rather brittle, and, therefore, could not be used as an imitation of boxwood, although its uniform fine structure makes an even polish possible and fits the wood for novelties.

Although none of the woods above mentioned has all the properties of true boxwood, the scarcity of this species makes their substitution in many cases justifiable.

Reconstruction in Europe

(Continued from page 228)

2,000 individuals temporarily brought together at a concentration or demobilization camp is quite another.

England is considering her problem both as applied to her huge army and her very largely increased navy, under a number of different heads—it will be impossible to go into all of them in detail, but their titles are sufficiently indicative of the points of view from which the problem has been attacked.

First, of course, comes the creation of military machinery for the demobilization itself—in itself no mean task. Next comes the vital question of transportation both by land and by sea, and it should be noted here that one of the limiting factors in speed in England, may well be the available wharves and docks which can be spared from commerce to berth the ships which carry troops. England faces also the organization of a new army, her regulars of 1914 being practically all either dead, wounded or otherwise incapacitated, or so scattered in the expansion of the present army as to make impossible their becoming even a nucleus of what army she will retain. The care of those unfit for civil life—the wounded, the mutilés, the helpless the blind, the gassed, the ones who are ruined in health from privation, exposure or German prison camps is a very vital matter in her demobilization scheme. Storage of arms, ammunition, equipment, ordnance, against any future disposition must be arranged before the materiel can be abandoned by the men who now have it in charge—naturally the millions of pounds sterling invested in materiel must not be thrown away, even if demobilization of the man power caring for it is slowed up, for the taxpayer must be considered as well as the fighting man. With this problem comes the disposition of animals, vehicles, stores, food. Not until these matters have been taken care of can the nation become adequately prepared to handle the dispersal of the individuals. Next comes the disbandment of military units no longer needed, payments finally settled to individuals, adjustment of accounts of military units, repatriation of prisoners and finally, horrible thought though it may seem to the altruistic, adequate plans for remobilization, without which not a wheel is turned in England's demobilization scheme.

It should not be understood by this that Great Britain expects another war, or is planning for one. But it would be futile to store cannon and ammunition or dock now unnecessary warships instead of sinking them, if no plans were made to man them should the need ever arise, and while the belief is universal in England that the war is over, that Germany is defeated for all time, and that the peace to be concluded is to be a lasting peace, nevertheless, like the wise traveler in desert places, she lays in a supply against the time of need, notwithstanding that she is "fed up" with war and all that appertains to war. The United States has the same idea, for our draft machinery and our registration records are such as to enable us to remobilize, if not with a "million men overnight" as one prominent Chautauquan has expressed it, at least with a speed beyond anything we have ever been able to attain before.

The order and method of British demobilization begins, of course, with the sick, wounded, multilated and war prisoners, as soon as they have been restored to the best possible physical and mental condition regardless of any other consideration affecting priority of release from service. Thus, a wounded man in hospital can look forward to immediate demobilization as soon as he is physically fit, even though he is unmarried and has no urgent civil life call.

Next comes demobilization of men called "Demobilizers," that is, those men required in either a military or a civil capacity for the work of demobilization—the men, in other words who will form the demobilization machine. They will be followed by what are called "pivotal" men, largely skilled artisans absolutely required in certain industries before such can be reëstablished, men who will thus, by their speedy reabsorption, be able to assist industry to absorb other workers. Steel testers, chemists, standardization experts, designers, technical engineers are cases in point. But in order to avoid even the appearance of unfairness, the numbers of men in both these classes will be limited in the extreme and only absolutely indispensible men included.

Third come what are called "slip" men. They are those who have some definite work awaiting them, who know exactly what they are going to do and where they are going to do it. They will be released in the order of the priority of their industrial groups.

Fourth comes those who have not jobs awaiting them, but whose trade or other employment in civil life is of such a character as to be of high importance in national reconstruction and who will probably have no difficulty in getting work immediately. Such men might be ship workers, coal miners, steel tool mechanics, etc.

Fifth come the other "non-slip" men, who have no definite employment ready and waiting for them, who will be demobilized in the order of their importance to civil life and finally the men selected to form the "cadres" or skeleton units of military bodies necessarily left out of the general scheme of demobilization to care for horses, guns, materiel, etc., as long as such care may be needed.

Within this general scheme comes the preferential device to take care of married men and men who have served the greatest length of time at the front, as well as time-expired soldiers and sailors who reënlisted for the war. Within each group as it is demobilized, preference will go to the married over the single, the long service over the short, the reënlisted soldier or sailor over the man who has not previously served his country.

Like the United States, Great Britain is attempting to get jobs for all her soldiers

(Continued on page 238)

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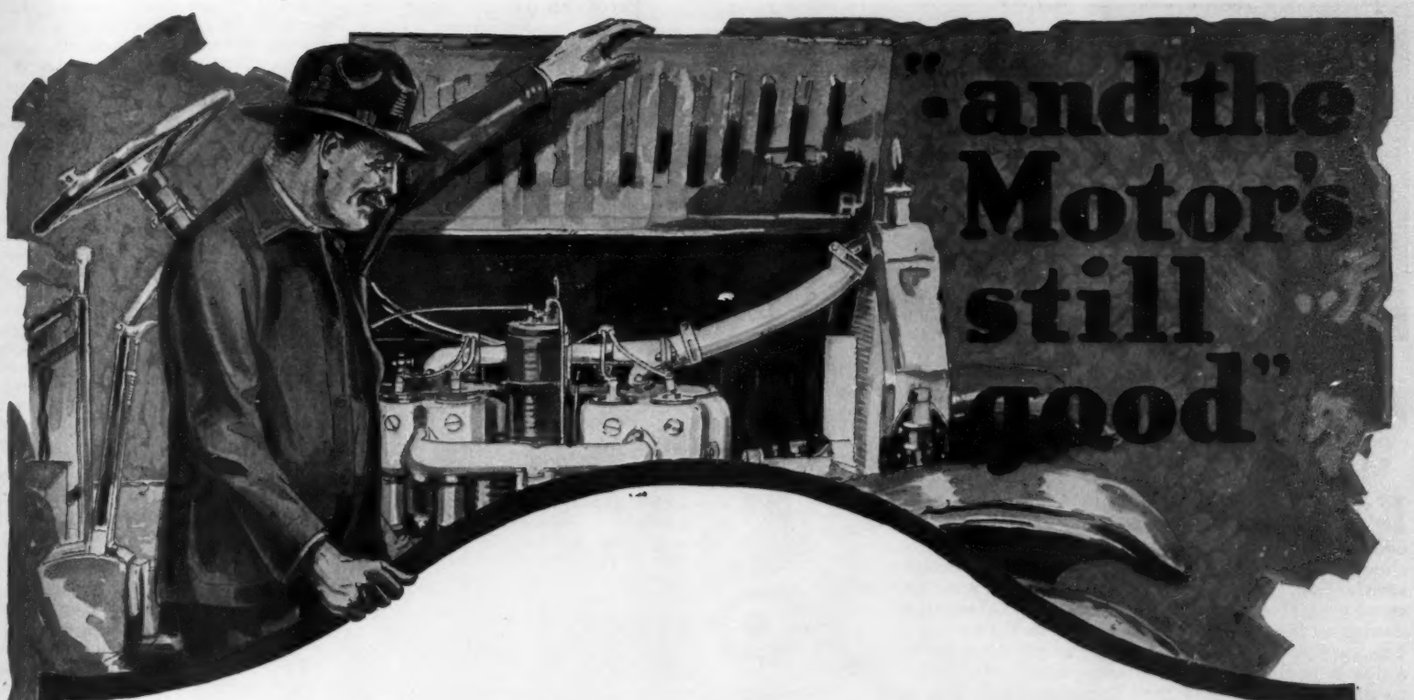

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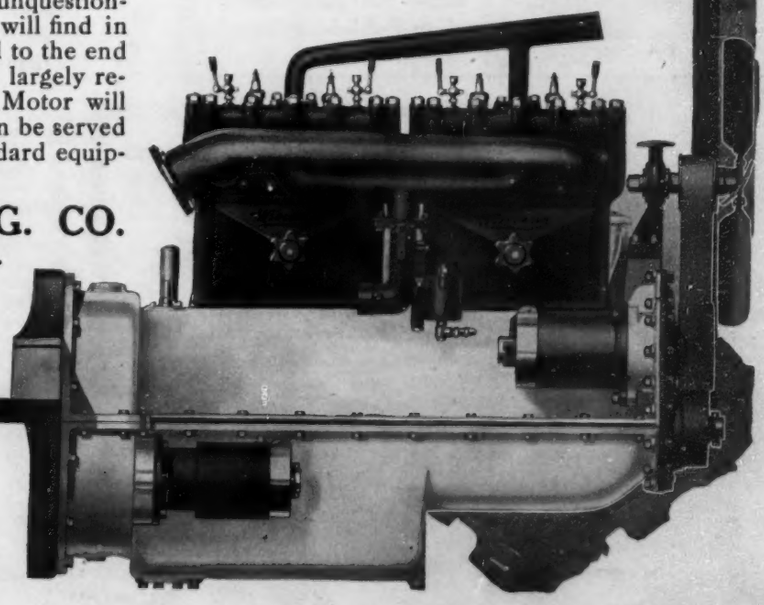

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Reconstruction in Europe

(*Continued from page 236*)

and sailors who do not have them ready and waiting and the Ministry of Labor has worked out a comprehensive scheme, not very different from that of our own Department of Labor, by which local advisory committees and local employment exchanges are aiding in the work. The question is somewhat complicated by the domination of industry by trades unionism, but helped, on the other hand, by prepeace agreements between particular trades unions and particular industries, by which priority of post-war employment is to be given those who served with the colors.

Meanwhile, it is interesting to note that educational training for soldiers in England has been in force for some time, and was started by British troops in France in 1918. This will be continued during demobilization so that those inclined can use the necessary period of mental, if not physical idleness, for learning various things.

Classes in 11 languages, economics, political economy, mathematics, chemistry, electric lighting and power, art and design, principles of mechanics, accountancy, agriculture, and indeed a vast list of practical subjects, are already being held.

Great Britain in general and England in particular has made some very brilliant plans for post-war improvements, and if they can be carried out, the world will see a great many innovations hitherto held as beneath the desire if not the dignity of many who prided themselves upon being not only British but English. That many men born to one trade or calling and held content in it through tradition and class feeling are now having opened up to them opportunities for improvement of mind and expansion of education, with the vista of breaking away from tradition and class distinction, is one of the revolutions which England is working in England — and the educational opportunity to be afforded men during demobilization delays is but the opening gun in this campaign.

Official List of Farm Tractors

(*Continued from page 232*)

the valves were improperly timed. This was inexcusable. What if the machine had gone out into some farmer's hands in that condition? This failure to make good the guarantee of the makers should stand as a severe indictment against the all too common practice of over-rating tractors.

Prospective purchasers should be very careful in the purchase of new and untried machines to make sure that the machine has undergone some sort of official test in the hands of unbiased parties. The farmer cannot afford to run experiments at his own expense.

High-Pressure Hydrant Regulation

By C. W. Geiger

(*Continued from page 234*)

nomically be allowed to stand in idlenes, awaiting another diastrophic upheaval, It should be freely employed as an aid to the regular fire-fighting system. But its use has been fraught with great danger, because there was no satisfactory way of controlling the pressure. Turning a stream of water against a building at any such pressure as 300 pounds would be more likely to wipe out the building than the fire would. Consequently the high pressure was employed but seldom; out of a total of 3,100 fires in 1917 it came into action in only 83 cases. Yet the great value of the high-pressure water in fire fighting is evident if only a reliable and satisfactory way could be devised to control the pressure at the hydrant.

After a great deal of experimenting an employee of the fire department, W. Gleeson, has succeeded in effecting such control. Through use of his reducing valve the hydrant can be started at a pressure of one pound, if such an extreme were necessary, and worked up gradually to 300 pounds, or to any desired point short of this. In practice, the stream is ordinarily started at 120 pounds and worked up from that to the appropriate strength. When necessary three of these valves can be connected to one hydrant, with two hose lines attached to each valve, giving six streams of water on the fire. At the same time the pressure can be varied between these lines, all six, though receiving their water from the single hydrant, being quite independent of one another as regards the delivery pressure. In this way some of the lines can do the heavy work of fighting the main blaze, while others at lower pressure can play upon some other part of the building where so high a pressure would not be desirable.

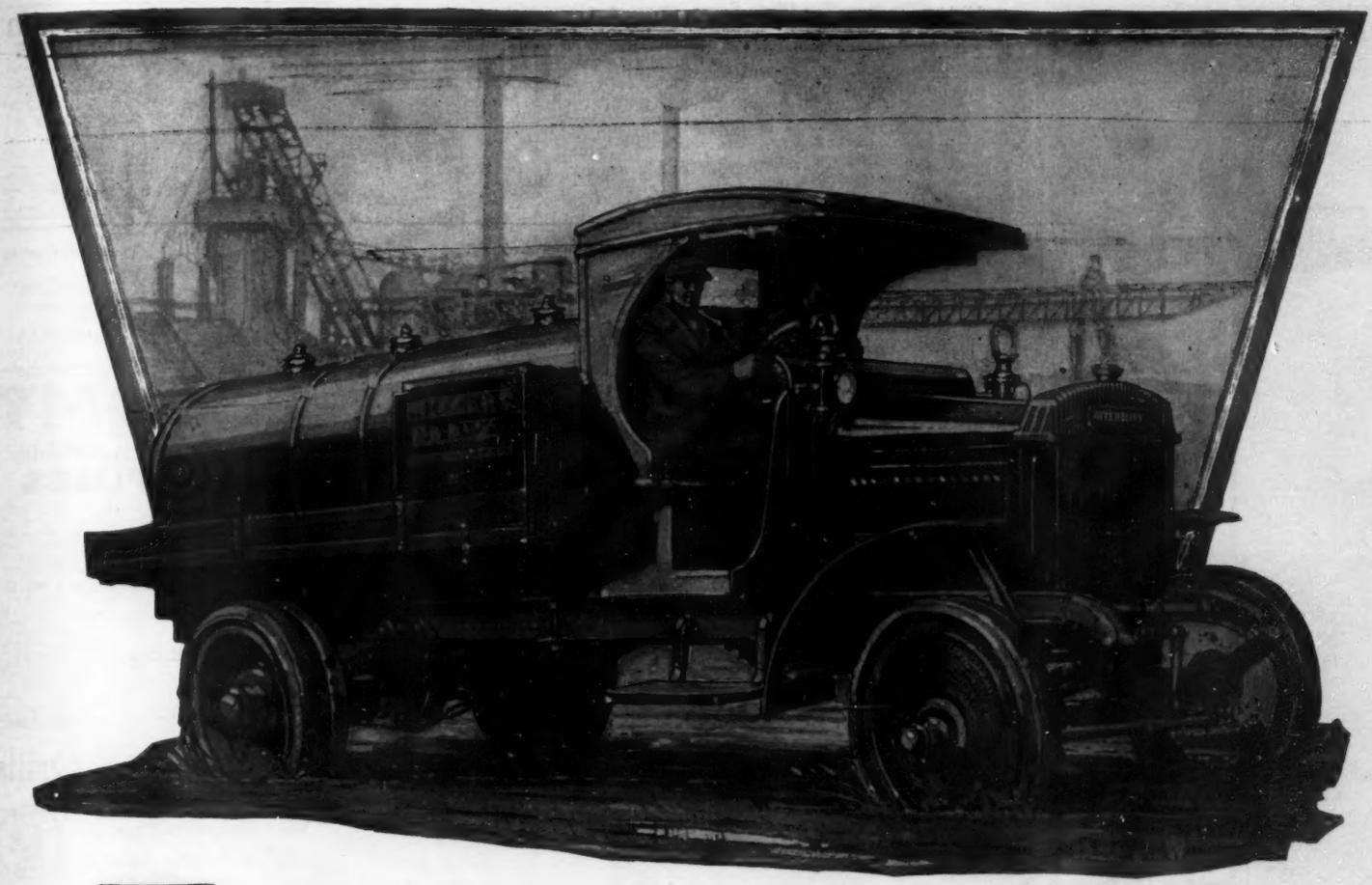
The opening and closing of the valve in regulating the pressure is performed by hydraulic pressure, eliminating all heavy springs and disks. The general principle is that of several chambers within the valve casting, into which water is admitted in such a way that the difference in pressure between the chambers causes the movements of the valve.

These chambers are at D, C and B. Water finds its way from the vestibule E through the port G into D. Water from D passes through the small port O into C, and from A into B via a similar port which cannot be shown in the diagram. A thumbscrew fitted with a graduated rack governs operation.

If the reducing valve is connected with a hydrant having pressure of 200 pounds, and the screw is then turned to read 200 pounds, the full force of the water will pass through the valve. There will then be a pressure of 200 pounds against the surface of the valve at E and at D, and as the surface areas of these chambers are equal, even pressure will be exerted in both directions. The surface of C is equal to the combined surfaces of B and A; with water pressure of 200 pounds in all three, they will exert even pressure in both directions, so the valve will be perfectly balanced.

A cock connected with chamber C, when open, permits the water to run out into the atmosphere, reducing the pressure in this chamber. When this occurs, the combined pressure in A and B will force the valve to its seat at E, shutting off the water. The area of the surface at D is now greater than that at E; hence there is a greater total force operating at D than at E, and the valve is held firmly against its seat. This inequality in area is brought about by the fact that in chamber E, a quarter inch of the surface on each side bears against the valve seat, so that the pressure area is four inches in diameter when the valve is open and only 3½ inches when closed. Once closed, the valve can only be opened by closing the cock in chamber C, which will equalize matters again and lift the valve from its seat, permitting the water to flow through the two outlets.

With hydrant pressure 200 pounds and the screw turned to 200 pounds, the pressure in chambers E, D, C, B and A is 200 pounds throughout. Suppose it is desired to reduce this to 100 pounds. The thumbscrew is turned until it reads that figure on the rack. Now chamber C has a port V permitting the water to escape into K. When the pressure in C is the same as that indicated on the thumbscrew rack, the valve S, connected with that rack, holds the water in chamber K. As soon as the balance between rack and pressure in C is disturbed by moving the screw, S is opened and water flows out of K until the pressure in it and in C is equalized at 100 pounds (in the case under discussion). This forces E to its seat until the pressure in A and B has been reduced to 100 pounds; and this will be the hose pressure, though the hydrant pressure be 200 pounds or any other amount. If we work in the other direction, and turn the thumbscrew from 100 to 150, water will accumulate in chambers C and K, instead of flowing out, until there is a uniform pressure of 150 pounds in these chambers. This will move the valve from its seat until the pressure in A goes to 150 pounds.



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Recovery of Tin from Tin-Plate Scrap

As the war has progressed the price of tin has advanced to levels heretofore thought impossible. Accordingly, while attention has always been directed to methods of recovering the tin from scrap, the importance of such operations has been greatly enhanced, and they have been undertaken on a scale never before approached.

The problem of recovery does not at first appear to be a difficult one, and it was bound to appeal to the inventor; for the can factories were glad to give away their scrap for the asking, or even to go so far as to pay to have it carried away. But in spite of the many avenues of attack seemingly open, it has required decades of study and experiment before a feasible method was developed yielding sufficiently valuable results to make it a paying proposition.

All the processes which have ever been actually operated may be divided into three general classes—mechanical, chemical and electro-chemical. In the mechanical process the effort was made to separate the tin from the iron by means of heat or, more recently, by refrigerator. Little success has attended such procedure, however, mainly because the methods seem fundamentally unadapted to obtain a thorough separation.

Most chemical and electro-chemical processes have also failed, either because the acids used attacked the iron as well as the tin, or because they would not dissolve the tin sufficiently and left considerable adhering to the iron. In many instances, also, the chemicals employed were too expensive to make the process a valid one financially. Three processes, however, have operated successfully for the past 40 years, being more or less in competition with one another, and alternating in temporary preponderance as now one, now another, benefitted from further refinements.

The exceedingly simple idea of electrolysis of tin scrap in an alkali solution involves chemical and mechanical difficulties of considerable magnitude, but these have all been met at one time or another. The process requires the greatest of watchful care; but since the tin is received at the cathode in the form of a spongy or finely granulated precipitate, which may easily be removed and melted, it offers conspicuous advantages. The ease with which the tine and iron may both be utilized when once they have been successfully separated by this process gave it the leading position in the field up to about 1907.

When dry chlorine is brought in contact with tin clippings, the chlorine and tin will combine and the anhydrous tetrachloride of tin which is formed will drip off. As chlorine at low temperatures does not attack iron, we have here what looks like a promising line of attack. But control of the chlorine gas and of the tin chloride fumes is difficult, and workmen are annoyed, if not actually endangered. Then, too, all humidity must be excluded in order to avoid a destructive effect upon the iron; while there must be complete freedom from organic materials such as paper, straw, varnish, etc., and finally, means must be found to keep the apparatus below the temperature at which the chloride would attack the iron. Since 1907 the German pioneers in the detinning industry have found a way of meeting all these conditions, however, and of carrying out the operations under a varying pressure so that the chlorine is forced into every part of the mass of tinned scrap; and accordingly the electrical detinning has largely been abandoned in favor of this method. A conspicuous advantage is the larger units in which the operation can be carried out.

Within very recent years there has been a tendency to return to the alkali treatment which is historically the oldest of all. The scrap is cleaned carefully and placed in a well-heated solution containing a considerable excess of free alkali and saltpeter or other oxidizer. After boiling, stannate of soda forms in crystals, which are drawn off and separated from the liquid by centrifugal action. The tin is then extracted from its connection with the soda, while the alkali itself and the saltpeter are recovered for use again and again, with little loss. The fact that the process is a circular one is the advantage which has led to its recent extensive reintroduction.

Toluol and the Gas Industries

THE importance of high explosives in the war has been amply demonstrated. Nearly all types of explosives are used in some way, but trinitrotoluol, because of its high power and great stability, is one of the preferred members of the class. It is used alone and in combination with other explosives; especially for naval use it is used alone, because its great stability permits unusually long storage of the shells before use. On account of the great demand thus created there has grown up also a large demand for those materials from which it is made, and especially for toluol. This latter substance finds numerous applications in the chemical industries, but above all else it is used in the manufacture of dyestuffs and for the preparation of trinitrotoluol.

Although toluol occurs in coal tar and is commonly spoken of as a coaltar product, there is really to be found in the tar only a small percentage of the total toluol originally distilled from the coal. Most of this constituent remains in the gas. This toluol, together with benzol, the xylols, and other related hydrocarbons, can be removed from the gas, affording what is known in its crude state as light oil. This light oil has not heretofore usually been removed from coke-oven or city-gas supplies because of the relatively small commercial demand for its constituents. The process for removal was well known, however, the principal one being the washing of the gas with a petroleum oil in which the light oils were dissolved and from which they were subsequently recovered by distillation.

Previous to the declaration of war in 1914, the production of toluol in the United States did not exceed 500,000 to 750,000 gallons per year. Most of this came from coal-tar distillation, but smaller amounts were prepared by refining the light oils removed from coke-oven gas in a few plants. At once after hostilities opened the demand for toluol increased greatly, and it became evident that the common sources of this material would not meet the new commercial demands. As a consequence a large increase in the recovery of toluol from coke-oven gas immediately followed, and more recently the recovery of this constituent from city gas supplies has also resulted.

To give an approximate idea of the scope of the industry thus developed, one need only compare the small output of pure toluol in 1912 and 1913, for which years it was approximately 500,000 gallons, with the estimated output for the year just past (1918), during which period it is hoped that the output will have exceeded 20,000,000 gallons. Practically all of this increase has been possible because of the recovery of toluol from coke-oven gas and city supplies.

The removal of toluol, benzol and other light oils from the gas causes a reduction in both the heating and the lighting value of the gas. Therefore city gas plants which are required to maintain certain qualities of product have found it necessary to consider the influence of this by-product industry upon their operating practice in order that the recovery of the constituents in question may not reduce the quality of the gas supplied by them below the legal standard. In some cases changes in operation practice are possible. In others reenrichment of the gas after removal of the light oil has been necessary. In still other cases modification of standards has been found desirable; especially

(Continued on page 248)

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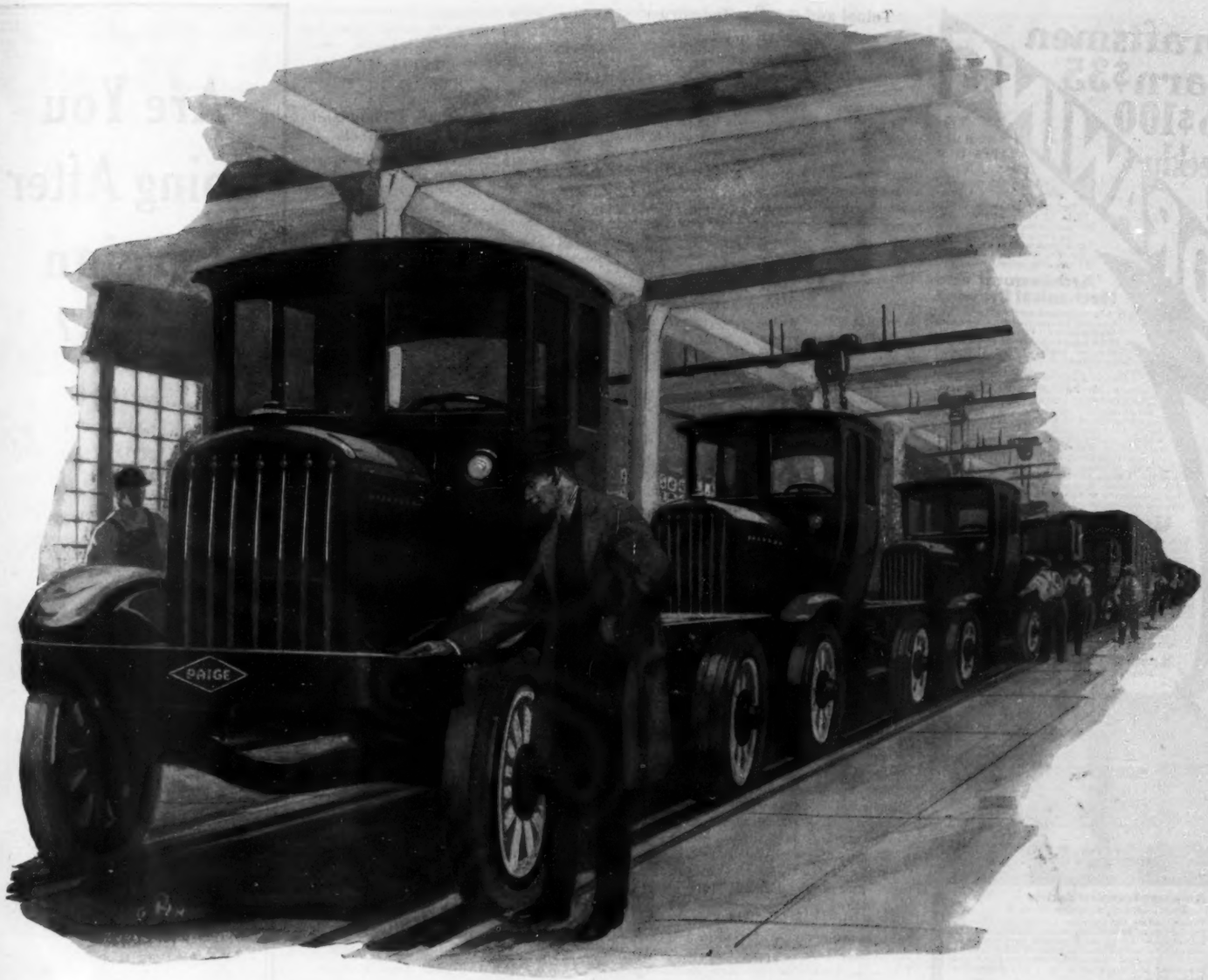

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Toluol and the Gas Industries

(Continued from page 240)

in the matter of candle-power; this is feasible in more and more localities as the use of mantles over illuminating jets becomes more and more widespread.

The Bureau of Standards has found that this entire development comes within the scope of its activities, and has kept its finger continually on the pulse of the toluol and gas industries. From time to time it has published reports and papers on one aspect or another of the situation; and it now finds the whole matter sufficiently crystalized to make possible the publication of what for the present at least ranks as a final summary of the procedures for recovery of toluol from gas. This paper is available for distribution to those interested, and may be had from the Bureau in Washington. It should be applied for under the title "Technologic Paper No. 117; Toluol Recovery."

Emigration After the War

AMONG the economic questions which will become more important as peace comes nearer is undoubtedly that of emigration. There will be a great demand for labor to rebuild all that which has been destroyed, even after the armies of millions have been demobilized and returned to productive work, and at the same time the trans-oceanic countries need of immigration, which during the war has almost stopped, will be reawakened with renewed strength. There will be a strong drawing on the neutral countries especially, which have been spared their populations, and it is therefore necessary for these countries to take timely measures to prevent such an exodus which plainly enough will have harmful results, according to the *Svensk Handelstidning* of Stockholm, Sweden.

The Dutch press has given a summary of measures already taken in this direction by the neutrals as well as the warring countries. In May there was started in Germany the "Reichsstelle fur deutsche Auswanderung und Ruckwanderung" to work for the return of Germans from foreign countries and at the same time to guard and replace their former properties. In England the Government has already started to make plans for the returning soldiers and their families in Canada, Australia, New Zealand and South Africa. Canada, Australia and New Zealand have already placed great tracts of land at their disposal, and so has South Africa, on a smaller scale. England has submitted an emigration law for second reading. It works against emigration of labor from England to other countries and also provides for certain restrictions on emigration to the colonies.

In Switzerland is the "Auswanderungsamt," which controls the work of emigration promoters. Austria-Hungary, like Germany, counts on the return emigration. Opinions have been expressed in favor of giving them land, inasmuch as most of the emigrants from Austria-Hungary have been farmers.

Italy can probably count on a balance of labor. The former seasonal emigration of land laborers to surrounding countries, on which a large economic profit has been based, will presumably be resumed. Considering the great war losses, there will surely be a few years' halt in the former large emigration to North and South America.

Because of the present good relations between Italy and France, it is quite possible that France will be fortunate to receive the seasonal emigration of Italian land laborers. The French emigration was not large before the war. On the contrary, there was considerable emigration to France from Italy, Spain, and Belgium. Regarding Belgium, there will undoubtedly be a strong check against emigration from that country, inasmuch as no country will be in as great need of man power as Belgium.

On the northern European countries will come the greatest drawing, not only by the other European countries which will need a maximum of skilled labor but also by America, where extensive establishments have already been started for the purpose of encouraging immigration, concludes this Swedish contemporary.

Shipping Subway Cars a Thousand Miles on Their Own Wheels

IT is used to be the practice to ship elevated railroad cars, subway cars and other cars intended for metropolitan railways, on flat cars. That means tieing up a large number of flat cars, which can ill be spared when every car has more than one job waiting for it.

So when it came to shipping the subway cars intended for New York city's new subways, the expedient of shipping these cars on their own wheels over a distance of one thousand miles was resorted to. Out of 477 subway motor cars, 307 motors and 140 trailer cars were shipped from the car building plant near Chicago, to New York city. Later, 30 cars were also sent in the same manner. When these cars were ready for shipment, inspection was made by the subway's inspection department.

In shipping the subway cars, they were first assembled in units of five, and M.C.B. drawbar heads and steps and grab handles were installed on the first and last cars of each unit in compliance with the Interstate Commerce Commission's ruling. All cars were equipped with special brake rigging suitable for shipping behind standard steam locomotives. The reason the M. C. B. drawbars were installed in units of five is that in case of a breakdown, a five-car unit could be dropped off at any terminal if temporary repairs could not be made. The side-tracked unit could then be attached at the rear end of the next shipment.

Thirty cars were shipped in one train from the car plant in charge of a representative from the subway company. The last car contained one mattress, one pillow, and two blankets for his use. For emergency purposes, there were carried in the last car 25 journal brasses, 10 gallons of journal oil, one pail of grease, one pail of saturated waste, and one packing iron. It was necessary for the messenger in charge of the train to supply himself with rations for a period of about four days.

When the subway cars were ready for shipment, the car builders took them to Burnside, Chicago, and they were then transferred to the Belt Line Railroad of Chicago, which in turn transferred them to the Lake Shore Railroad at South Chicago. There was sometimes a delay of twelve to twenty-four hours before cars could be transferred to the Lake Shore Road due to the blocking of the road.

When cars were finally turned over to the Lake Shore Road, a crew consisting of one engineer, two brakemen, and one conductor was called by the yardmaster to take the train to Elkhart, Ind., the first stop between Chicago and New York, where the cars were inspected and all journals lubricated.

At each division different crews took charge. Between Chicago and Cleveland, an average speed of 20 miles per hour was maintained, while between Cleveland and New York city, the speed was 25 miles.

Upon arrival in New York city at the Highbridge Yard, all cars were thoroughly inspected to see if any of them had been damaged in transit, in which case the railroad company was held responsible.

The average time from Pullman, Ill., to Highbridge, New York, was two to three days. The distance is roughly 1,000 miles. On occasion it has been necessary to replace a journal brass on the road from Chicago to New York due to overheating, but as a general rule no trouble has been experienced in shipping subway cars on their own wheels over this great distance.

Cars are stored at Highbridge yard until they arrive at the construction shop of New York's Interborough system. They are there relieved of their temporary brake rigging, steps, grabhandles and drawbar heads, and these accessories are returned to the car builders by freight.

Are You Going After Foreign Trade?

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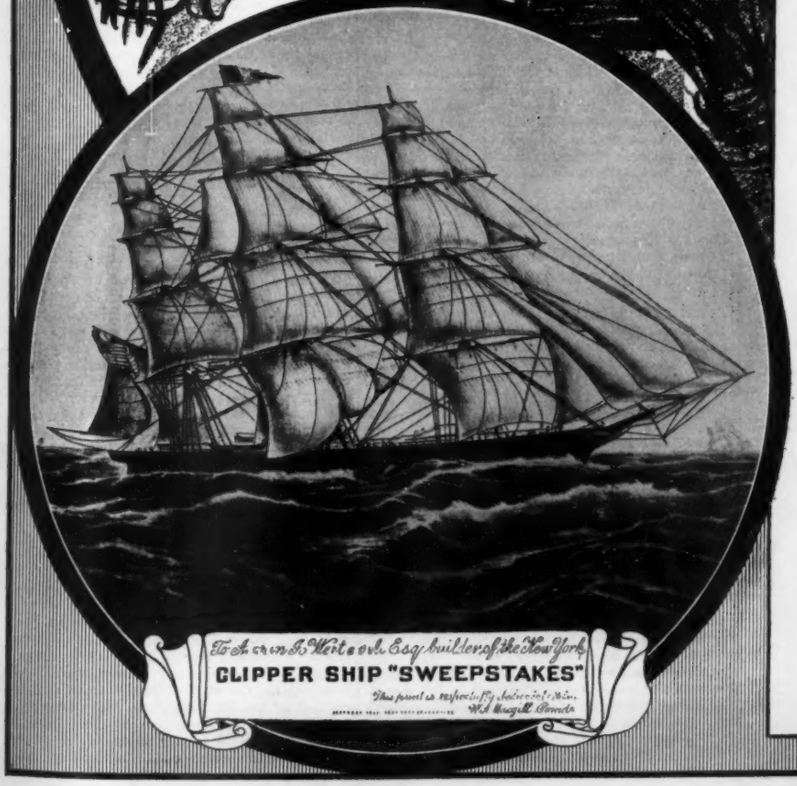
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In the days of our former supremacy on the Seven Seas it was the woodman's axe which put at the disposal of our ship builders the material from which our ships were fashioned. Today a stick of dynamite used by the miner takes the place of the axe.

The huge tonnage of steel ships launched along our coasts during the past year is due largely to the fact that metals are mined with dynamite instead of by hand for as steel has succeeded wood for ship building so has the use of dynamite succeeded many crude and laborious methods formerly employed not only in mining but also in engineering, construction and agricultural work.

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NEW BOOKS, ETC.

THE HUMAN MACHINE AND INDUSTRIAL EFFICIENCY. By Frederic S. Lee, Ph.D., LL.D. New York and London: Longmans, Green and Co., 1918. 12mo.; 119 pp.; illustrated. Price, $1.10 net.

Professor Lee, whose work in physiological efficiency is well known, here concerns himself with seeking a sound physiological basis upon which to build efficiency, and aids the industrial establishment in developing it. While the material is particularly applicable to war industries, the expounded principles may be put to wide uses. Among other considerations are the qualifications of workers, output and fatigue, the length of the working day, the labor turnover, women compared with men, night work compared with day work, accidents, welfare work, food, scientific management, and the physiological organization of work.

MAKING THE OFFICE PAY. Edited by W. H. Leffingwell. New York and London: A. W. Shaw Company, 1918. 8vo.; 404 pp.; illustrated. Price, $4 net.

"Making the Office Pay" is a well-printed and well-illustrated book presenting plans, methods and systems successfully used by hundreds of business men; its object is to increase profits by cutting costs. Your present difficulty may lie in the routing of work, the output of typists, or the hiring and training of employees. No matter what the problem may be, this work teaches you to study it from every angle, and shows how others have found a solution for similar difficulties. Ideas germinate from ideas, one method suggests another. While the book gives perfected plans suited to many different conditions, its chief service is in teaching the office manager to think constructively, and to adapt other men's achievements to his own ends. The charts, schedules and forms it offers are worthy of the closest study.

THE BOSTON AND LOWELL RAILROAD, THE NASHUA AND LOWELL RAILROAD, AND THE SALEM AND LOWELL RAILROAD. By Francis B. C. Bradlee. Salem, Mass.: The Essex Institute, 1918. 8vo.; 64 pp.; illustrated.

The early days of New England railroading were the early days of many other things, and for those who feel the spell of the past, and for those also who use the past merely as a standard for the progress of the present, this retrospect shows the railroad displacing the coach, industry stretching and rubbing its eyes, and far-sighted pioneers infusing new life into the sluggish pulse of the times. The plates depict early locomotives and stations, boats and wharves, and the tickets in use 40 years ago. There is much solid information as to the number of passengers carried, rules for employees, wages, timetables, and financing.

UNITED STATES ARMY X-RAY MANUAL. Prepared under the Direction of the Division of Roentgenology. New York: Paul B. Hoeber, 1918. 8vo.; 506 pp.; 219 illustrations. Price, $4.

This manual supersedes the small guide hastily prepared at the beginning of the war, and evidences the knowledge and good judgment of those responsible for its make-up. Most phases of roentgenology are covered: dangers and protection are discussed, new apparatus described, the localization of foreign bodies is given generous space, and the military roentgenologist is taught to make accurate findings and to so record them that they will be of maximum use to the surgeon. In diagnosis, established facts only are dealt with, and controversial points have been avoided. Separate chapters take up the bones and joints, sinuses and mastoids, teeth and maxillae, thoracic viscera, urinary tract, and gastro-intestinal tract.

PELOUBET'S SELECT NOTES ON THE INTERNATIONAL SUNDAY SCHOOL LESSONS FOR 1919. By Rev. F. N. Peloubet, D.D. and Amos R. Wells, Litt.D., LL.D. Boston, 1918. W. A. Wilde Company. 8vo.; 374 pp. Price, $1.25.

This is the forty-fifth annual volume and is interesting not only as a valuable working tool for Sunday School teachers but it also brings out many facts of a scientific nature which a book of this kind need not necessarily disclose. It is a beautiful piece of book-making and reflects great credit upon the publishers.

LIBERTY MAP OF THE WESTERN FRONT OF THE GREAT WORLD WAR. New York, Funk & Wagnalls Co. Price, $4.50.

This is an excellent map, mounted on cloth, on a scale of eight miles to the inch, covering the entire Western Front and extending into Germany far enough to include the neutral zone as established by the armistice on November 11th, 1918. It is accompanied by an index of all the principal towns and rivers, comprising over 11,000 names. An insert on a scale of about 170 miles to the inch covers the entire area of the war in Europe and Asia Minor, serving to show the relation of the Western Front to the rest of the war area. Indicated on the map are the battle lines of October 1st, 1918, and of November 11th, 1918, when armistice took effect, the battle line before the German offensive of 1918, the extreme advance of the Germans in 1918, their farthest advance in 1914, and the farthest advance of the French in 1914. A smaller insert shows the coal and iron fields in the western war territory, and there is a diagram giving the relative production of pig-iron and coal by the Allies and the Central Powers. Altogether, the map will make a very comprehensive addition to any man's library.

THE HUMAN SKELETON. An Interpretation. By Jerbert Eugene Walter, Associate Professor of Biology, Brown University. New York: The Macmillan Company, 1918. 8vo.; 214 pp.; illustrated. Price, $1.75.

Professor Walter would make everyone better acquainted with the architecture of the human frame, and he goes to work in such a way that the reader is interested from the start. Its evolution and its utility are developed, chapter by chapter, with numerous illustrations in the text and some fine full-page plates. In these readable chapters he deals with the make-up of the skeleton, Nature's experiments with skeletons, the external trimmings, the oldest part, and the thoracic basket, the evolution of the brain case, the human skull, changing fashions in skulls, the locomotor skeleton, and the handy hand and the makeshift foot.

A SMALL BOOK ON ELECTRIC MOTORS. For Continuous and Alternating Currents. By W. Perren Maycock, M.I. E.E. New York: Isaac Pitman and Sons, 1918. 8vo.; 192 pp.; 128 illustrations. Price, $2.

For those who are interested in knowing about ordinary motors and motor controls, without going too deeply into technical details. This treatise supplies the groundwork knowledge that the general reader is only too glad to get, setting forth the advantages of electric power in industry and in the home, explaining various types of motors and control-gear, and adding descriptions and definitions of electrical matters and terms. The excellent and abundant illustrations are an outstanding feature of the instructions so admirably given.

PRACTICAL AVIATION FOR MILITARY AIRMEN. By Major J. Andrew White, Chief Signal Officer, American Guard. New York: Wireless Press, Inc., 1918. 8vo.; 197 pp.; 200 illustrations. Price, $1.75 net.

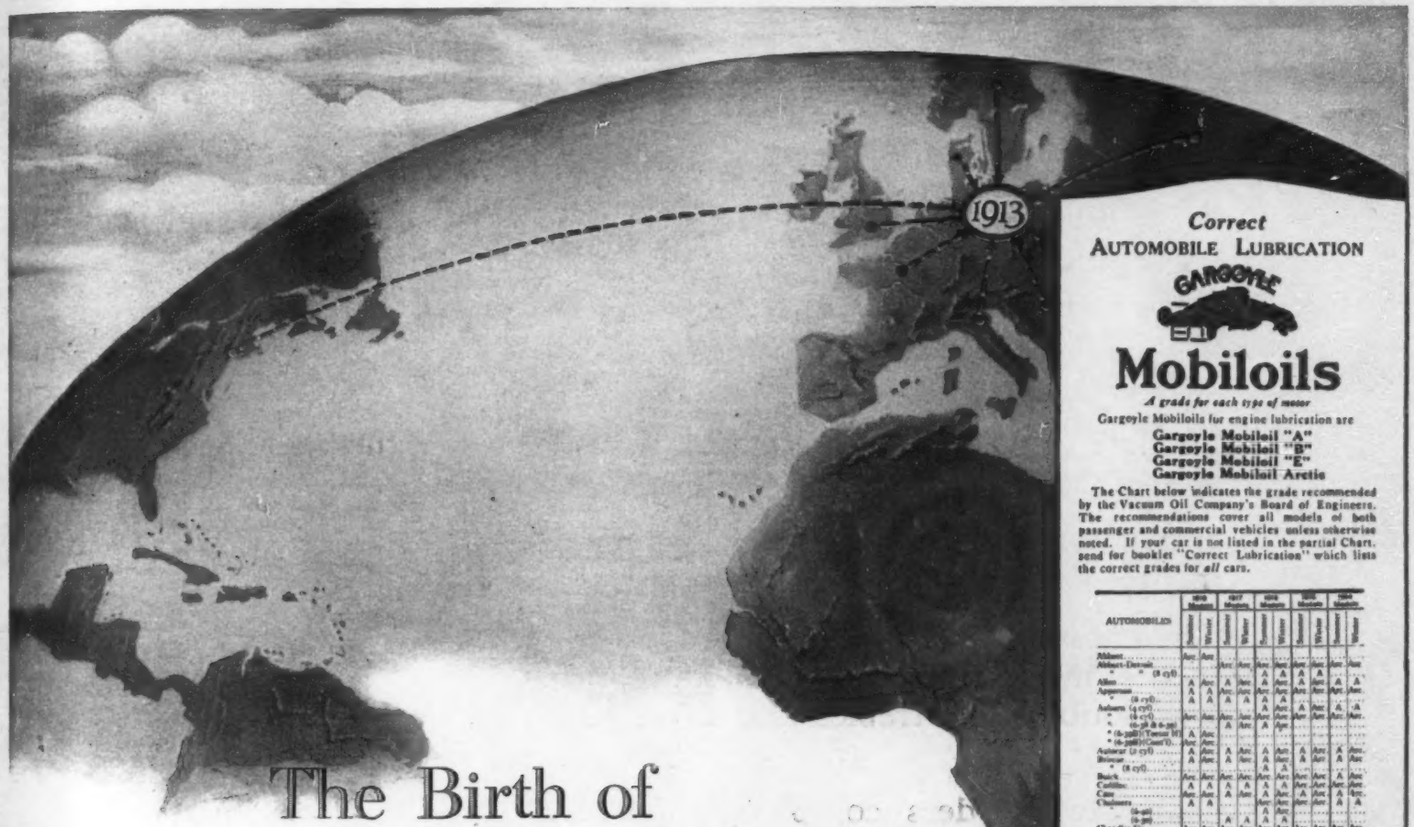
Major White has given us a unique and eminently helpful presentation of the knowledge required in military aviation—an intensive study in which every word counts. The typographical arrangement is unusual, but effective; it reproduces as closely as possible the teachings of the class room, and all text explanatory of the fine illustrations is so placed in relation to them that no turning of the page is required—each page constitutes a brief blackboard talk. The work first presents the fundamentals required prior to actual flying; the instruction includes operation and care of engines, reconnaissance, map reading, signaling and cooperation with military bodies, radio and its uses, machine gunnery, and bombing from airplanes. It is a splendid text for either individual or class study.

BALDNESS. Its Causes, Its Treatment and Its Prevention. By Richard W. Muller, M.D., A.M.A. New York: E. P. Dutton and Company. 8vo.; 178 pp.; illustrated. Price, $2 net.

In this treatise by a specialist we are told what science knows about the human hair, how to preserve it and how to prevent its falling out. The investigations and discoveries of both native and foreign authorities are incorporated in the book, and a measure of hope is held out to those whose hair is thin or grey. The use of light rays, which has produced some striking results, receives adequate attention, as indeed do all other proved methods. The work is strictly scientific and conservative in spirit, and is addressed especially to physicians, but there is much in it that patients themselves would be benefited by learning.

INTRODUCTORY METEOROLOGY. New Haven: Yale University Press, 1918. 8vo.; 162 pp.; illustrated. Price, $1.

The course of study outlined by the Committee on Education and Special Training of the War Department for Students Army Training Units includes meteorology, so that prospective officers may, by intensive study, quickly grasp the main conclusions and methods. This excellent text is offered, under the auspices of the National Research Council, for use in connection with a course in military geology. The manuscript was prepared by the staff of the Weather Bureau, assisted by outside authorities. The condensed, practical treatment and fine illustrations make it an ideal supplementary work for the regular high school and college curriculum and for Army and Navy training units.



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AUTOMOBILES	1913 Models		1917 Models		1916 Models		1915 Models		1914 Models	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Abbott	Arc	Arc								
Abbott-Detroit			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)					A	A	A	A		
Allen	A	Arc	A	Arc	A	Arc	A	Arc	A	A
Apperson	A	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)	A	A	A	A	A	A				
Auburn (4 cyl)					A	Arc	A	Arc	A	A
" (6 cyl)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (6-38 & 6-39)			A	Arc	A	Arc				
" (6-39B) (Texas M)	A	Arc								
" (6-39B) (Coast'l)	Arc	Arc								
Autocar (2 cyl)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Reinar	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (8 cyl)			A	A						
Buick	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
Cadillac	A	A	A	A	Arc	Arc	Arc	Arc	Arc	Arc
Case	Arc	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Chalmers	A	A			Arc	Arc	Arc	Arc	A	A
" (6-40)					A	Arc				
" (6-36)			A	A	A	A				
Chandler Six	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Chevrolet	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
" (8 cyl)	A	A	A	A						
" (F A)	A	Arc								
Cole					Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)	A	A	A	A	A	A	A	A		
Cunningham							Arc	Arc	Arc	Arc
" (8 cyl)	A	Arc	A	A	A	A				
Dort	A	Arc	A	Arc	A	Arc	Arc	Arc	A	A
" (Mod. C)			A	Arc	A	Arc	A	Arc	A	A
" (2 & 3/4 ton)	A	A								
Detroit	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc	A	A
Dodge Brothers	A	Arc	A	Arc	A	Arc	E	E		
Dort	A	Arc	A	Arc	A	Arc	A	Arc		
Empire (4 cyl)	A	Arc	A	Arc	A	Arc	Arc	Arc	Arc	Arc
" (6 cyl)	Arc	Arc	Arc	Arc	Arc	Arc				
Federal	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (Mod. S-K)	A	A	A	A						
" (Special)	Arc	Arc								
Flat	B	A	B	A	B	A	B	A	B	A
Ford	E	E	E	E	A	A	A	A	E	A
Franklin	A	Arc	A	A	A	Arc	A	A	A	A
Grant	A	Arc	A	Arc	A	Arc	Arc	Arc	Arc	Arc
Hal-Twelve			A	A	A	A				
Haynes	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
(12 cyl)	A	A	A	A	A	A				
Hupmobile (8 cyl)	A	A	A	A						
(6 cyl)	A	A	A	A	A	A	A	A		
Hudson	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (Super Six)	A	Arc	A	Arc	A	Arc				
Hupmobile	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Jackson			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)	A	A	A	A	A	A				
Jordan	Arc	Arc	Arc	Arc						
Kelly Springfield	A	A	A	A	A	A	A	A	A	A
King							A	Arc	A	A
" (12 cyl)	A	A	A	A	A	A				
" (Conv'l)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Kissel Kar	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (Mod. 48)					A	A	A	A	A	A
" (12 cyl)	A	A	A	A						
Lexington	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Liberty (Detroit)	Arc	Arc	Arc	Arc						
Lippard Stewart	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (Mod. M)			Arc	Arc						
" (Mod. MW)			Arc	Arc						
Locomobile	A	E	E	E	E	E	E	E	E	E
McFarlan	A	Arc	A	Arc	A	Arc	A	Arc		
Madison	A	Arc	A	Arc	A	Arc	Arc	Arc		
" (8 cyl)			A	A	A	A				
Marion	A	A	A	A	A	A	A	A	A	Arc
Marmon	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Mercer	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (35-70)					Arc	Arc				
Meteor	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (8 cyl)			A	A						
Moline-Knight	B	A	A	A	A	A	A	A	A	A
National	A	Arc	Arc	Arc	A	Arc	A	Arc	A	Arc
" (12 cyl)	A	A	A	A						
Oakland	A	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)	A	A								
Oldsmobile	A	A	A	A	Arc	Arc	Arc	Arc	Arc	Arc
" (6 cyl)	A	A								
Overland	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Owen Magnetic	A	Arc	A	Arc	A	Arc				
" (Mod. M-24)	A	A	A	A						
Packard							A	Arc	A	Arc
" (12 cyl)	A	A	A	A	A	A				
" (Com'l)	A	A	A	A						
Paige (4 cyl)					A	Arc	A	Arc		
" (6 cyl)	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc	A	A
" (6-36)					A	Arc				
" (6-38, 39)			A	Arc						
" (6-46)	A	Arc								
Paterson	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Pathfinder					A	Arc	A	Arc	Arc	Arc
" (12 cyl)			A	A	A	A				
Peerless	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)	A	A	A	A	A	A				
Pierce Arrow	A	A	A	A	A	A	Arc	Arc	Arc	Arc
" (Com'l)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Premier	A	A	A	A	A	A	Arc	Arc	Arc	Arc
Regal	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)					A	A	A	A		
Renault (French)					A	Arc	A	Arc	A	Arc
Reo	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Riker	E	E	E	E	E	E	E	E	E	E
Saxon	E	E	E	E	E	E	E	E	E	E
Selden	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (35 ton)			A	A	Arc	Arc				
Simplex			A	A	A	A	Arc	Arc	Arc	Arc
Stearns-Knight	B	A	A	A	A	A	B	A	B	A
" (8 cyl)	B	A	A	A	B	A				
Studebaker	A	A	A	A	A	A	Arc	Arc	Arc	Arc
Stutz			A	A	A	A				
Velie (4 cyl)							A	Arc	A	Arc
" (6 cyl)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (2 & 3/4 ton)	Arc	Arc								
" (35 ton)	Arc	Arc								
Westcott	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
White	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (16 valve)	A	A	A	A						
Willys-Knight	B	A	A	A	B	A	B	A	A	A
Willys Ute	Arc	Arc	Arc	Arc						
Wisconsin	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc

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GMC Trucks at Pre-War Prices

The announcement of a reduction of $200 in the price of the GMC Model 16, 3-4 ton truck, is good news to truck buyers.

Back of this action is an interesting story of war p. duction of which little has been told.

The General Motors Truck Company is one of the largest builders of motor trucks. Prior to the close of the war fully 90% of its production was for the government.

But it was building **GMC trucks** for the government—GMC models selected by the government.

The enormous government demand made extensive improvements in manufacturing facilities necessary. The capacity was doubled and trebled and every possible efficiency measure adopted.

With war orders completed, we have proceeded without factory changes or alterations in design—we are continuing quantity production.

We are making the same high grade trucks that the government selected and standardized after they had been proved by years of government service and had successfully stood every test, under official scrutiny.

The reputation that GMC trucks have made, not only in government service, but among the best business concerns throughout the world, is one we are p. oud of.

We cannot afford to, and **will not** cheapen our trucks in any particular; we constantly make them better when we can.

But we can and have reduced the price on all six models of GMC trucks to the lowest point consistent with their high quality and a legitimate manufacturer's profit.

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Pontiac Michigan

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GMC TRUCKS